AIKTC/KRRC/SoET/ACKN/QUES/2019-20/ **Date:** 15/01/2020

School: SoET-CBSGS **Branch:** MECH. ENGG. **SEM:** V

To,
Exam Controller,
AIKTC, New Panvel.

Dear Sir/Madam,

Received with thanks the following **Semester/~~Unit Test-I/Unit Test-II~~ (Reg./ATKT)** question papers from your exam cell:

Sr. No.	Subject Name	Subject Code	Format		No. of Copies
			SC	HC	
1	IC Engines	MEC501		✓	02
2	Mechanical Measurement & Controls	MEC502		✓	02
3	Production Process – III	MEC503		–	–
4	Theory Of Machine – II	MEC504		✓	02
5	Heat Transfer	MEC505		✓	02
6					

Note: SC – Softcopy, HC - Hardcopy

(Shaheen Ansari)
Librarian, AIKTC

TE-sem-V - CBSGS - Mech 21/11/19

(3 Hours) [Total Marks: 80]

Note: 1. Q.No.1 is **compulsory.**
2. Attempt any **Three** question from Q.No.2 to Q.No.6
3. Make suitable assumptions if required

Q.No.1 Solve Any **Four** **(5*4)**

a) Why the actual cycle efficiency is much lower than Air Standard Cycle efficiency.

b) Define Octane Number, Cetane Number and HUCR.

c) Describe how I.P. of a multi cylinder engine is measured? Mention the assumption made.

d) What are the A/F ratio requirements of S.I. Engine under various operating conditions.

e) State the advantages and disadvantages of battery ignition system. What is a function of condenser.

Q.No.2 a) What are the criteria for a good combustion chamber? Explain with a neat sketch pre combustion chamber used in C.I. Engine. **(10)**

b) The percentage analysis of gaseous fuel by volume is given as follows: **(10)**

CO_2 = 8 %,CO =22 %, O_2 = 4 %, H_2 = 30 %,and N_2 =36 %.Determine the minimum volume of air required for complete combustion of 1 m^3 of gas, Calculate the percentage composition by the volume of the dry product of combustion .If 1.4 m^3 of air is supplied per m^3 of gas, what will be the percentage by volume of CO_2 in the dry product of combustion.

Q.No.3 a) During an engine trial on a six cylinder four stroke diesel engine ,cylinder bore 180 mm, the stroke 200 mm, the following observations were recorded : speed 1500 rpm, BP = 245 kW , mep = 8 bar ,fuel consumption:70 kg/hr, heating valve of fuel 44 MJ/kg , Hydrogen content of the fuel 12%, air consumption 28 kg/min., mass of cooling water 85 kg/min., cooling water temperature rise 42 ^{0}C,cooling oil circulated through the engine =50 kg /min, temperature rise of cooling oil =24 ^{0}C ,specific heat of cooling oil 2.1 kJ/kgK, room temperature 30 ^{0}C, exhaust gas temperature 400 ^{0}C,Cp of the dry exhaust gas 1.045 kJ/kgK, partial pressure of the steam in a exhaust gases 0.035 bar. Estimate the mechanical efficiency and Draw of the heat balance sheet. Take h_{fg}= 3060 kJ/kg **(12)**

b) Explain the phenomenon of diesel knock .Compare it with the phenomenon of detonation in SI engines. **(08)**

TURN OVER

Q.No.4 a) The average indicated power in a C.I. engine is 15 kW/m^3 of free air inducted per minute. It is a four stroke engine having swept volume 3.4 liter. The speed of the engine is 3300 rpm and has a volumetric efficiency 80% referred to free air conditions of 1.013 bar and 22^{0}C. It is proposed to provide with a blower , driven mechanically from the engine . The blower has a pressure ratio 1.8 & adiabatic efficiency 75%. It can be assumed that at the end of suction , in the supercharged condition ,the cylinder contain a volume of air equal to the swept volume at the pressure & temperature of delivery from the blower. Calculate the net increase in break power. Take Mechanical efficiency = 80% **(12)**

b) Describe Turbocharging. State the different methods for Turbocharging? **(08)**

Q.No.5 a) State pollutants emitted by petrol engine and effects of following factors on exhaust emission i) air fuel ratio ii) Surface to volume ratio. **(08)**

b) The venturi of a simple carburetor has a throat diameter, 24mm & the coefficient of discharge 0.81. The fuel orifice is of 1.10 mm diameter & the coefficient of discharge 0.67.The petrol surface is 4 mm below the throat, **calculate,** **(12)**

i) A/F for pressure drop of 0.82 bar, when nozzle lip is neglected.

ii) A/F when lip is taken account.

iii) The minimum velocity to start the flow when lip is provided. Density of air 1.2 Kg/m^3 & density of fuel 750 Kg/m^3

Q.No.6 a) A four stroke C.I. engine develops 25 kW per cylinder, at 2500 rpm. The specific fuel consumption is 0.30 kg/kW-k for a fuel with 30° API. The fuel is injected at a pressure of 150 bar over a crank travel of 25°. The pressure in the combustion chamber is 40 bar. Coefficient of velocity is 0.875 and specific gravity is given by S.G=(141.5/131.5+°API) Calculate the diameter of the fuel injector orifice. **(10)**

b) State the necessity of engine cooling and also state disadvantages of overcooling **(05)**

c) Briefly explain VCR engine **(05)**

TE-Sem-V-CBGS-Mech 1:9/11/19

Paper / Subject Code: 31002 / MECHANICAL MEASUREMENT AND CONTROL

(3 Hours) **[Total marks: 80]**

Instructions:
1. **Question 1 compulsory.**
2. Attempt any **three** questions from the remaining **five** questions.
3. Assume suitable data, **if necessary.**
4. **Figures/sketches** carry weightage.

Q1) a) Explain the constructional features and working of non-contact type of velocity measurement device with a neat sketch 10

b) Explain the generalized measurement system with a neat sketch and example 10

Q2) a) Explain Interfering input, Desired input and Modifying input for measurement 7

b) What do you understand by Mathematical modelling? What is its significance and practical applications? Comment. 7

c) Illustrate the working principle of "L.V.D.T." for displacement measurement. 6

Q3) a) Illustrate the working of Nozzle Flapper with a neat sketch d) 8

b) The output power of a rotating shaft is measured by a dynamometer. The relationship for output power is - 12

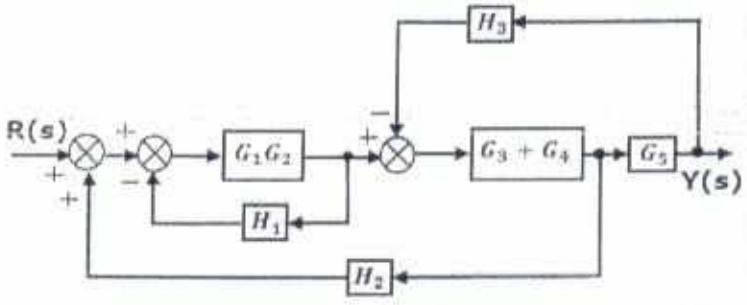
$$P = \frac{2\pi \times 9.81 FLR}{t \times 10^6} KW$$

Where;
F = Force at the end of torque arm, kg ;
L = Length of torque arm, mm ;
R = Number of revolutions during time t,
t = Time for test run, S.

The test data are -
F = 4.58 ± 0.02 kg
L = 397 ± 1.3 mm
R = 1202 ± 1.0 revolutions
t = 60 ± 0.50 second

The errors are limiting (absolute) errors. Determine the magnitude of power and magnitude of the limiting error in the computed power

Q4) a) Obtain the Transfer function for the Block diagram using Standard Block reduction rules. 10



b) Enumerate the types of pressure measurement devices w.r.t. to pressure levels to be measured. State the working principle of any one transducer for each pressure level. 10

Q5) a) Unity feedback system has open loop T.F. G (s) = K / s (1+Ts) where K and T are constants. Determine factor by which gain K should be multiplied so that overshoot of unit step response be reduced from 75% to 25%. 10

b) Sketch the Root Locus for the given system having G (s). H (s) = K(s + 4) /s (s^2 + 2s+ 2). Comment on its stability. 10

Q6) a) Write short note on PI & PID controllers. 10

b) A system having, 10

$$G(s)\,H(s) = \frac{K(s+2)}{s(s+4)(s+10)}$$

Find K to get PM=30°

Paper / Subject Code: 31001 / THEORY OF MACHINES-II

(3 Hours) [Total Marks ; 80]

N.B. 1) Question No. 1 is **compulsory**
2) Answer any **Three** questions from remaining **Five**
3) Assume suitable data wherever required, justify the same
4) Answer to questions showed be grouped and written together.

Qu. 1 Solve **any Four** **20**

a) Define dynamically equivalent systems. State the condition necessary to make two systems dynamically equivalent.
b) How does a brake differ from that of a dynamometer?
c) What do you understand by gyroscopic couple? Derive a formula for its magnitude
d) Explain the necessity of gear box in automobile.
e) Why single plate clutches are dry whereas multi plate clutches are wet?

Qu. 2 a) The upper arms of a porter governor are pivoted on the axis of rotation and the lower arms are attached to the sleeve at a distance of 3.76 cm from the axis. The length of the arm and suspension links are 30 cm. the weight of each ball is 60 N and load on the sleeve is 480 N. if the extreme radii of rotation of governor balls are 20 cm and 25 cm. find the corresponding equilibrium speeds. **10**

b) If the capacity of a single plate clutch decreases by 13% during the initial wear period, determine the minimum value of the ratio of internal diameter to external diameter for the same axial load. Consider both the sides of the clutch plate to be effective. **10**

Qu. 3 a) The turbine rotor of ship has a mass 2.2 tonnes and rotates at 1800 rpm clockwise when viewed from the aft. The radius of gyration of the rotor is 320 mm. Determine the gyroscopic couple and its effect when **10**
a) The ship turns right at a radius of 250 m with a speed of 25 km/h.
b) The ship pitches with the bow rising at an angular velocity of 0.8 rad/s
c) The ship rolls at an angular velocity of 0.1 rad/s.

b) The semi-cone angle of a clutch is 12.5^0 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 200N? **10**
If the clutch is used to connect an electric motor with a stationary flywheel, what is 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.

Qu. 4 a) The crank and the connecting rod of a vertical single cylinder gas engine running at 1800 rpm are 60 mm and 240 mm respectively. The distance of the piston is 80 mm and mass of the reciprocating parts is 1.2 kg. At a point during the power stroke when **10**

the piston has moved 20 mm from the top dead center position, the pressure on the piston is 800 kN/m^2. Determine

i) The net force on the piston
ii) The thrust in the connecting rod
iii) The thrust on the sides of the cylinder walls
iv) The engine speed at which the above values are zero.

b) In the band and block brake, having 14 blocks each of which subtends an angle of 15^0 at the center, is applied to drum of 1m 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 30mm and 120mm from the fulcrum. If a force of 200 N is applied at a distance of 750 mm from the fulcrum, find
a) Maximum braking torque, b) Angular retardation of drum, and c) time taken by the system to come to rest from the rated of 360 rpm. Take $\mu = 0.25$ **10**

Qu. 5 a) The total mass of a four-wheeled trolley car is 1800 kg. The car runs on rails of 1.6m gauge and rounds a curve of 24 m radius at 36 km/hr. the track is banked at 10^0. The external diameter of the wheel is 600 mm and each pair with the axle has a mass of 180 kg with radius of gyration of 240 mm. The height of the center of mass of the car above the wheel base is 950 mm. Determine the pressure on each rail allowing for centrifugal force and gyroscopic couple actions. **10**

b) A punching press executes 20 holes of 2cm diameter per minute in a plate 1.5 cm thick. This causes the variation of speed in the flywheel attached to the press from 250 rpm to 225 rpm. The punching operation takes 1.5 second per hole. Assume 500 N-m of the work to be done to shear 1 cm^2 of the area and that the frictional losses account for 15% of the work supplied for punching. Find **10**
(i) Power needed to operate the punching press in kW.
(ii) Mass of flywheel with radius of gyration 0.5 m

Qu. 6 a) In a spring controlled Hartung type governor, the length of the ball arm is 84 mm and the sleeve arm 126 mm. when in the mid-position, each spring is compressed by 60 mm and the radius of rotation of the mass centers is 160 mm. The mass of sleeve is 18 kg and of each ball 4 kg. Spring stiffness is 12 kN/m of compression and total lift of the sleeve 24 mm. Determine the ratio of the range of speed to the mean speed of the governor. Also, find the speed in the mid-position. Neglect the moment due to the revolving masses when the arms are inclined. **10**

b) In an epicyclic gear train, the internal wheels A and B and compound wheels C and D rotate independently about axis O. the wheels E and F rotate on pins fixed to the arm G. E gears with A and C and F gears with B and D. all wheels have same module and number of teeth are $T_C = 28$, $T_D = 26$, $T_E = T_F = 18$ **10**

1) Find the number of teeth on A and B
2) If the arm G makes 100 rpm clockwise and A is fixed, find the speed B;
3) If the arm G makes 100 rpm clockwise and A makes 10 rpm counter clockwise, find the speed of wheel B.

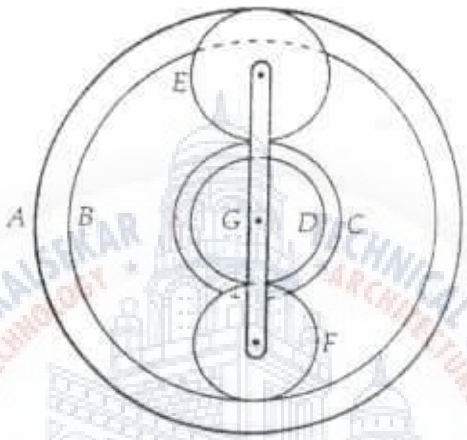


Fig. No. 1

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Paper / Subject Code: 31005 / HEAT TRANSFER

TE-sem-5-CBGS-Mech. 27/11/19

Time: 3 Hours Marks: 80

N. B : (1) Question no.1 is **Compulsory**.
(2) Attempt any **THREE** from question no.2 to 6.
(3) Use illustrative diagrams wherever possible.
(4) Assume suitable data if necessary and mention it clearly.
(5) Use of steam table is permitted.

Q.1 Answer any **Four** questions : **20**

a) What do you understand by critical thickness of insulation? Derive an expression for critical radius of insulation for a spherical surface with usual notations.
b) Differentiate between the mechanism of film wise and drop wise condensation.
c) What are the various types of fins? Discuss some of the important applications of fins
d) What is Heat exchanger? Draw Temperature profile for Parallel flow and Counter flow heat exchanger, Condenser, Evaporator.
e) Explain Hydrodynamic and Thermal Boundary Layer.

Q.2 a) A steam pipe of length 1m and 5cm inside diameter and 6.5 cm outside diameter is insulated with a 2.75 cm radial thickness of high temperature insulation (k= 1.1 W/m.K). The surface heat transfer coefficient for inside and outside surfaces are 4650 W/m^2.K and 11.5 W/m^2.K, respectively. The thermal conductivity of pipe material is 45 W/m.K. If the steam temperature is 200^{0}C and ambient air temperature is 25^{0}C,determine ;i) Heat lost per meter length of pipe ii) Temperature at the interface iii) Overall heat transfer coefficient based on inner and outer radius **12**

b) Write short note on- **8**
i) Lump system analysis
ii) Heisler charts

Q.3 a) Air at 27°C is flowing across a tube with a velocity of 25 m/s. The tube could be either a square of 5 cm side or a circular cylinder of 5 cm diameter. Compare the rate of heat transfer in each case, if the tube surface is at 127°C. **10**
Use $Nu = C (Re)^n (Pr)^{1/3}$
Where, C =0.027, n =0.805 for cylinder
C =0.102, n =0.675 for square tube.
Properties of air at 77°C,
ρ =0.955 kg/m^3, k_f=0.03 W/mK, v =20.92 X10^{-6} m^2/s, Pr =0.7,
Cp =1.009 kJ/kgK.

b) Prove that the total emissive power (E) of a diffuse surface is equal to π times its intensity of radiation(I). **10**

Q.4 a) Steam in a condenser of a steam power plant is to be condensed at a temperature of 30^{0}C with a cooling water from nearby lake, which enters the tube of condenser at 14^{0}C and leaves at 22^{0}C. The surface area of the tubes is 45 m^2 and an overall heat transfer coefficient is 2100W/m^{2}K.Calculate the mass flow rate of cooling water needed and rate of steam condensation in the condenser.Treat the condenser as counter flow heat exchanger. **10**

Cp of water at 18°C is 4.18kJ/kg.K and latent heat of vaporization at 30°C is h_{fg} =2430.5kJ/kg

b) State and explain the following laws- 10
   i) Plank's law
   ii) Kirchhoff's law

Q.5 a) An enclosure measures 1.5 m x 1.75 m with a height of 2 m. Under steady state equilibrium conditions, the wall and ceiling are maintained at 525 K and floor at 400 K. Determine the net radiation to floor. 6
ε_1(emissivity of ceiling and wall) =0.85
ε_2 (emissivity of floor) =0.75
take σ (Stefan-Boltzman constant)=5.67 x 10^{-8} W/m^2 K^4

b) The inside temperature of furnace wall ,200mm thick, is1350°C.The mean thermal conductivity of wall material is 1.35W/m°C.The heat transfer coefficient of the outside surface is a function of temperature difference and is given by 6
h=7.85+0.08Δt
where Δt is the temperature difference between outside wall surface and surroundings .Determine the rate of heat transfer per unit area if the surrounding temperature is 40°C .

c) Derive an expression for the effectiveness of a parallel flow heat exchanger in terms of the number of transfer units (NTU) and the capacity ratio[C_{min}/C_{max}]. 8

Q.6 a) Explain physical significance of i) Reynold's number ii) Nusselt's number 4

b) In a quenching process a copper plate of 3 mm thick is heated up to 350°C and then suddenly, it is dropped into a water bath at 25°C. Calculate the time required for the plate to reach the temperature of 50°C.The heat transfer coefficient on the surface of the plate is 28 W/m^2.K. The plate dimensions may be taken as length 40cm and width 30cm. 8
Take the properties of copper as
C=380J/kg.K, ρ =8800 kg/m^3,k=385W/m.K

c) Water at the rate of 0.8 kg/s at 90°C flows through a steel tube having 25 mm ID and 30 mm OD. The outside surface temperature of the pipe is 84°C and temperature of surrounding air is 20°C. The room pressure is 1atm. and pipe is 15 m long. How much heat is lost by free convection in the room? 8
Take characteristic length (L_c) =D_o=30 mm
You may use correlation
Nu = $0.53(Gr.Pr)^{0.25}$ ..... for $10^4 < Gr.Pr < 10^9$
=$0.10\ (Gr.Pr)^{1/3}$ ..... for $10^9 < Gr.Pr < 10^{12}$
Take properties of air as
ρ =1.0877 kg/m^3, k_f=0.02813W/m.K, μ = 1.9606 x10^{-5}kg/m.s
Cp =1.0073 kJ/kg.K

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