AIKTC/KRRC/SoET/ACKN/QUES/2018-19/ **Date:** _____

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		✓	02
4	Theory Of Machine – II	MEC504		✓	02
5	Heat Transfer	MEC505		✓	02
6					

Note: SC – Softcopy, HC - Hardcopy

(Shaheen Ansari)
Librarian, AIKTC

(17) TE-sem-V - CBSGS - Mech 21/5/19

Paper / Subject Code: 31003 / I.C. ENGINEERING

Q. P. Code: 25266

Time: 3 Hours Marks: 80

NB: - 1) Draw neat sketches whenever necessary.
2) **Q. No. 1** is compulsory.
3) Solve any **Three** questions from the remaining **Five** questions.
4) Assume suitable data wherever necessary.

Q.1 Solve any **five** from following six questions : **20**

a) Explain why rich mixture is required at the starting.

b) Justify - variation in specific heat is responsible for changes in efficiency of air standard efficiency of engine.

c) In air standard Otto-cycle, the compression ratio is 10. The condition at the beginning of the compression process is 100 kPa and 27 ^{0} C. Heat added at constant volume is 1500 KJ/Kg, while 700 kJ/kg of heat is rejected during the other constant volume process in the cycle. Specific gas constant for air =0.287 kJ/kg K. Find the mean effective pressure (In kPa) of the cycle.

d) Explain effects of spark advancement and retardation on the engine performance.

e) Explain that the requirement of air motion and swirl in CI engine combustion chamber is much more stringent that in an SI Engine.

f) Explain why turbocharged engines may have inferior values of power output and fuel consumption than naturally aspirated engines especially at low speed.

Q.2 a) The air fuel ratio of a diesel engine is 29:1 and compression ratio 16:1. The temperature at the end of compression being 900 K. Assume that the combustion begins at the TDC and takes place at constant pressure. Take calorific value of fuel as 42 MJ/Kg. R = 0.287 KJ/kgK, Cv = (0.709 + 0.000028 T) KJ/kgK. Find at what percentage of stroke combustion completes. Show the diesel cycle on PV diagram with state point numbers. **10**

b) A single jet carburetor is to supply 6 kg/ min of air & 0.44 kg/min of petrol of specific gravity 0.74. The air is initially at 1 bar & 27 ° C. Assuming an isentropic coefficient of 1.35 for air, determine **10**
(i) the diameter of the venturi if the air speed is 90 m/s and the velocity coefficient of venturi is 0.85 (ii) the dia of the jet, if the pressure drops at the jet is 0.8 times the pressure drop at the venturi, and the coefficient of the discharge for the jet is 0.66.

Q.3 a) A six cylinder four stroke engine develops 200 KW at 1200 rpm and consumes 0.3 kg/kWh. Determine the size of the single hole injector nozzle if the injection pressure is 160 bar and pressure in combustion chamber is 40 bar. The period of injection is 30° of crank angle. Specific gravity of fuel is 0.85 and orifice discharge coefficient is 0.7. **10**

b) What are the different functions of lubricating system ? State the different lubricating systems used for I C Engines. Explain any one of them. **10**

Q.4 a) A test of one hour duration was conducted on a single cylinder engine having a bore of 300 mm and stroke of 450mm. fuel consumed is 8.8 kg at an average speed of 200rpm. The mean effective pressure of the engine 5.8 bar and calorific value of fuel is 41800 kJ/kg. The brake friction load is 1860 N for a brake wheel of diameter of 1.22 m. Quantity of cooling water consumed during the test is 650 kg with a rise in temperature of 22°C. Draw the heat balance sheet on hourly and percentage basis and also Calculate: i) Mechanical efficiency , ii) Brake thermal efficiency **10**

b) Explain the types of combustion chambers used in SI engines and compare them. Why maximum diameter of SI engine combustion chambers is limited ? **10**

Q.5 a) In a test of a single cylinder 4 stroke diesel engine with bore 400 mm and stroke 450 mm, the following observations were made: **10**
Duration of test = 1 hr
Fuel Consumption = 7.5 kg
Indicated mean effective press = 3.75 bar
Calorific value of fuel = 44500 KJ/Kg
Total Air consumption = 361 kg
Total Revolutions = 12000
Net brake load = 1500 N
Brake drum diameter = 180 cm
Rope diameter = 3 cm
Quantity of cooling water used = 600 kg
Temperature rise = 42 ^{0} C
Exhaust gas temperature =300 ^{0} C
Room Temperature = 20 ^{0} C
Cp for exhaust gases = 1.01 KJ/KgK
Calculate:
1) Mechanical Efficiency 2) Indicated and Brake thermal Efficiency 3)
Draw heat balance sheet on minute basis.

b) With neat sketch explain compression induced swirl and divided combustion chamber. Also state its advantages and disadvantages. **10**

Q.6 a) Write short note on (**Any four**) : **20**
i) Thermosyphon cooling system
ii) Exhaust gas recirculation
iii) Turbo charging v/s supercharging
iv) Alternative fuels in I C Engine
v) Air box method
vi) VCR Engine

****

17E36DB05955128D9E32F0CE5FA68F32

(5) TE-sem-V-cbsgs-Mech-MMC 15/5/18

03 Hrs [Total Marks 80]

N.B.:
(1) **Question No.1 is compulsory**
(2) Attempt any **three**questionsout of remaining **five** questions
(3) Figures to right indicate full marks
(4) Assume suitable data if **necessary**.
(5) Notations carry usual meaning.

Q.1 (A) Derive an expression for steady state error when step and ramp input is given to the system. 8

(B) Define the following terms with reference to the state space modelling of the system. 06
(a) State space (b) State variables

(C) What are thermistors? Explain their different forms of construction. 06

Q.2 (A) What is mathematical modeling? Explain the importance of mathematical modelling in control systems. 06

(B) Explain the construction, working and theory of thermal conductivity gauges for measurement of vacuum. Explain how radiation effects are minimized. 06

(C) Obtain the state-space equation and output equation for the system defined by the equation, 08

$$\frac{Y(s)}{U(s)} = \frac{2s^3 + s^2 + s + 2}{s^3 + 4s^2 + 5s + 2}$$

Q.3(A) Describe the construction and working of a Rotameter. Derive the expression or the volume flow rate. Explain its advantages and disadvantages. 10

(B) For a system having $G(s) = \frac{15}{(s+1)(s+3)}$, $H(s) = 1$, determine 10
(i) Characteristic equation (ii) $\omega_n$and damping ratio (ξ)
(iii)Time at which Ist overshoot will occur
(iv) Time period of oscillations
(v) No. of cycles output will perform before settling down

TURN OVER

TE - Sem-V - CBSGS - Mech

(2)

Paper / Subject Code: 31004 / PRODUCTION PROCESS- III

27/5/19

Time : 3 hours **Marks: 80**

Note 1 All questions carry equal marks.
2 Question number one is compulsory.
3 Solve any three questions from remaining questions.
4 Assume suitable data if necessary.

Q.1 Answer **any four** of the following. **20**

i) Write the classification of automatic machines.
ii) Write short note on flexible manufacturing system.
iii) Explain general arrangement of two plate injection mould.
iv) Write short note on jig bushes.
v) Why pilots are used on progressive die? Explain types of pilot.
vi) Explain principle, advantages and limitations of Electron beam machining.

Q.2 a) Explain principles used for designing jigs and fixtures. **10**
b) With the help of neat sketch explain any three types of clamps. **10**

Q.3 a) Why jig should have four feet not three? **05**
b) Write the design principles used for the turning fixtures. **05**
c) Write the classification of presses. **05**
d) What do you mean by bending allowance? Write the factors affecting it. **05**

Q. 4 Write short note on the following.
i) Types of strippers. **05**
ii) Double action redraw die. **05**
iii) Combination die. **05**
iv)With the neat sketch, write the principle and working of abrasive jet machining. **05**

Q.5 a) With neat sketch explain feed system. What is the balanced feed system? Also write factors affecting runner size. **10**
b) What is ejection system? List ejection techniques and explain any one of them with neat sketch. **10**

Q.6 a) What is agile manufacturing? Also write enablers of agile manufacturing. **10**
b) Explain with neat sketch, principle, working, advantages, limitations & applications of USM. **10**

****

(10)

T.E - sem-V - Mech - CBSGS

9|5|19

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

Q.P. Code: 22662

(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.

Q. 1 Solve **any Four** 20

a) Define dynamically equivalent systems. State the condition necessary to make two systems dynamically equivalent.

b) What is the condition for self- locking and self -energizing of the brake?

c) Explain the necessity of gear box in automobile.

d) Why single plate clutches are dry whereas multi plate clutches are wet?

e) What do you understand by gyroscopic couple? Derive a formula for its magnitude.

f) Explain the following terms with reference to a governor-
(i)Sensitiveness (ii) Stability (iii) Isochronism (iv) Coefficient of insensitiveness

Q. 2 a) 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

b) 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

Q. 3 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/h. 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) 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?
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. 10

Q. 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 the piston has moved 20 mm from the top dead center position, the pressure on the piston is 800 kN/m^2. Determine 10

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.

{Turn Over

b) 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.

Q. 5 a) In the band and block brake, having 14 blocks each of which subtends an angle of 15° 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 10

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 $\mu = 0.25$

b) 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

Q. 6 a) 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. 10
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

(i) Power needed to operate the punching press in kW.
(ii) Mass of flywheel with radius of gyration 0.5 m

b) In an epicyclic gear train as shown in **Fig. No.1**. The wheel C is keyed to shaft B and wheel F is keyed to shaft A. The wheels D and E rotate together on a pin fixed to arm G. The number of teeth on wheels C, D, E and F are 35, 65, 32 and 68 respectively. If the shaft A rotates at 60 rpm and shaft B rotates at 28 rpm in the opposite direction, find the speed and direction of rotation of arm G. 10

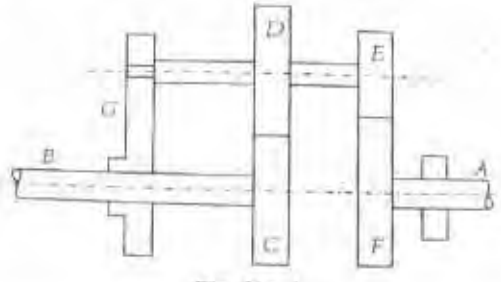

Fig. No. 1

(5)

TE - sem - V _ CBSGS - Mech

Paper / Subject Code: 31005 / HEAT TRANSFER

31/5/19

Time : 3 Hours **Marks: 80**

Note: - (1) Question No. 1 is compulsory
(2) Answer any Three out of reaming Five
(3) Make suitable assumption, if necessary

Q1. Solve any Five **(5*4)**

a) A steam pipe is insulated to reduce the heat loss. However, the measurement reveals that the rate of heat lost has increased instead of decreasing .Can you comment why?

b) How does a fin enhance heat transfer at a surface? What are the various types of fins? List the assumptions made while analyzing the heat flow from a finned surface.

c) What is lump system analysis? What are the assumptions made in the lumped system analysis and when is it applicable?

d) When heat transfer through a fluid layers is by conduction and when it is by convection? For what case, the rate of heat transfer is higher?

e) What are the limitations of LMTD method? How is Effective – NTU method superior to LMTD method?

f) State and explain Wien's displacement law.

Q.2 a) A thermocouple junction of spherical form is 8 mm diameter. **(10)**
Properties of the material are:
C = 420 J/kg-K, ρ = 8000 kg/m^3, k = 40 W/m-K and h = 40 W/m^{2}K.
This junction is initially at 40°C and inserted in a stream of hot air at 300°C.
Find:
(i) Time constant of the thermocouple
(ii) The thermocouple is taken out from the hot air after 10 seconds and kept in air at 30°C. Assuming the heat transfer coefficient in air 10 W/m^2 K, find the temperature attained by the junction 20 seconds after removing from hot air.

b) Derive Fourier's differential equation in the Cartesian Co-ordinate. **(10)**

Q.3 a) A refrigerated truck is moving on a highway at 90 km/h in a desert area where the ambient air temperature is 50°C, the body of the truck may be considered as a rectangular box measuring 10 m (Length) × 4 m (Width) × 3 m (Height). Assuming that the boundary layer on the four walls is turbulent, the heat transfer takes place only for the four surfaces and the wall surface of the truck is maintained at 10°C. Neglecting heat transferred from the front and back and assuming the flow to be parallel to 10 m long side, Calculate the following: **(10)**

1. The heat loss from the four surfaces.
2. The power required to overcome the resistance acting on the four surfaces.

Use the equation: $Nu = 0.036(Re)^{0.8}(Pr)^{0.33}$ if $Re_l > 1\times10^5$

The properties of air at 30 C :

ρ = 1.165 kg/m^3; Cp = 1.005 kJ/kgK; k = 0.02673 W/m-K; $\nu = 16\times10^{-6}$ m^2/s; Pr = 0.701

b) For transient heat conduction, with negligible internal resistance, with usual notations, show that: $\frac{\theta}{\theta_o} = \exp\left(-B_i . F_o\right)$ Also state the significations of 'B_i' and 'F_o'. **(10)**

Q.4 a) Two stroke motor cycle cylinder consists of 15 fins. If the outside and inside diameters of each fin are 200 mm and 100 mm respectively, the average fin surface temperature 475 C and atmospheric air temperature is 25 C, calculate the heat transfer rate from the fins for the following cases. **(10)**

(i) When the motor cycle is stationary

(ii) When the motor cycle is running at the speed of 60 km/h

The fin may be idealized as single horizontal flat plate of the same area. Use significant length

L = 0.9D to calculate Gr and Re.

Use equation $Nu = 0.54(Gr \times Pr)^{0.25}$ if nature of flow is laminar i.e. $Gr.Pr < 10^9$ and

$Nu = 0.036(Re)^{0.8} \times (Pr)^{0.33}$ if nature of flow is turbulent.

The properties if air at 250 C:

$k = 0.04266$ W/m-K; $\nu = 40.61 \times 10^{-6}$ m^2/s; $Pr = 0.677$

b) 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}. **(10)**

Q.5 a) A parallel flow heat exchanger has hot and cold water streams running through it and has the following data: **(10)**

Mass flow rates of hot and cold water are 10 kg/min and 25 kg/min respectively. Inlet and outlet temperatures of hot water are 70°C and 50°C respectively. Inlet temperature of cold water is 25°C. Individual heat transfer coefficient on both sides = 60 W/m^{2}K. Calculate:

(i) Area of heat exchange.

(ii) Exit temperatures of hot and cold fluids if hot water flow rate is doubled.

b) Define Shape factor and discuss its properties. Derive an expression for shape factor for **(10)**

(i) Hemispherical shape of radius R (ii) Two concentric cylinders.

Q.6 a) Consider two large parallel plates one at $T_1 = 727$ C with emissivity $\varepsilon_1 = 0.8$ and other at $T_2 = 227$ C with emissivity $\varepsilon_2 = 0.4$. An aluminum radiation shield with an emissivity $\varepsilon_3 = 0.05$ on both side is placed between the plates. Calculate the percentage reduction in heat transfer rate between two plates as a result of the shield. **(10)**

Use $\sigma = 5.67 \times 10^{-8}$ W/m^{2}K^4

b) Write short note on any **two** of the following **(10)**

i) Heisler Charts.

ii) Boiling curves and various regimes of boiling.

iii) Heat Pipe.

****