MECH

TE/IV | CBGS | MECH | Heat Transfer | 04/06/15

QP Code : 3267

(3 Hours) **[Total Marks : 80**

Question no.1 is compulsory.
Attempt any **THREE** from question no. 2 to 6.
Use illustrative diagrams where ever possible.

Q1) Solve any **Four** 20

a) What is meant by film condensation and dropwise condensation?

b) What is Fin? What are the various types of fins?

c) Explain the number of transfer units (NTU).

d) Define Thermal Diffusivity and state its significance.

e) Define: Radiosity and Irradiation.

Q2) a) Derive the relation for heat transfer through fin with insulated tip. State the assumptions clearly. 10

b) Explain the term 'Time Constant' of a thermocouple. 03

c) A copper wire of radius 0.5 mm is insulated uniformly with plastic (k = 0.5 W/m K) sheathing 1 mm thick. The wire is exposed to atmosphere at 30^0C and the outside surface coefficient is 8 W/m^2 K. Find the maximum safe current carried by the wire so that no part of the insulated plastic is above 75^0C. Also calculate critical thickness of insulation. For copper: thermal conductivity = 400 W/m K, specific electrical resistance = 2 X 10^{-8} ohm-m. 07

Q3) a) Using dimensional analysis, derive an expression for forced convection:- 08

Nu = Constant X $(Re)^m$ X $(Pr)^n$

b) Air at atmospheric pressure and 20^0C flows with 6 m/s velocity through main trunk duct of air conditioning system. The duct is rectangular in cross-section and measures 40 cm X 80 cm. Determine heat loss per meter length of duct corresponding to unit temperature difference. 08

The relevant thermo-physical properties of air are: $\nu = 15 \times 10^{-6}$, $\alpha = 7.7 \times 10^{-2}$ m^2/hr, k = 0.026 W/m-deg.K

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

[TURN OVER

c) What is meant by Fouling in Heat Exchangers 04

Q4) a) Distinguish between specular and diffuse radiation. 04

b) Prove that the total emissive power of black surface is π time the intensity of radiation. 06

c) 16.5 kg/s of the product at 650^0C ($c_p = 3.55$ kJ/kg K), in a chemical plant, are to be used to heat 20.5 kg/s of the incoming fluid from 100^0C ($c_p = 4.2$ kJ/kg K). If the overall heat transfer coefficient is 0.95 kW/m^2 K and the installed heat transfer surface is 44 m^2, calculate the fluid outlet temperature for the counter flow and parallel flow arrangements. 10

Q5) a) Derive the relationship between the effectiveness and the number of transfer units for a parallel flow heat exchanger. 10

b) A thermocouple indicates a temperature of 800^0C when placed in a pipeline where a hot gas is flowing at 870^0C. If the convective heat transfer coefficient between the thermocouple and gas is 60 W/m^{2}K, find the duct wall temperature. ε (thermocouple) = 0.5 05

c) A thin copper sphere with its internal surface highly oxidised, has a diameter of 20 cm. How small a hole must be made in the sphere to make an opening that will have an absorptivity of 0.9? 05

Q6) a) Write a short note (any **Two**) 08

1) Heisler chart
2) Importance of numerical methods
3) Heat Pipe

b) Draw the boiling curve and identify the different boiling regimes 05

c) A 15 mm diameter mild steel sphere (k = 42 W/m ^{0}C) is exposed to cooling airflow at 20^0C resulting in the convective coefficient h = 120 W/m^2 ^{0}C. 07

Determine the following:

(i) Time required to cool the sphere from 550^0C to 90^0C.

(ii)Instantaneous heat transfer rate 2 minutes after the start of cooling.

For mild steel take: $\rho = 7850$ kg/m^3, c = 475 J/kg ^{0}C, $\alpha = 0.045$ m^2/h

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Sem V / IC Engineering / 25-5-15 MECH

QP Code : 3260

(3 Hours) [Total Marks: 80

NB: 1) Question number **one** is compulsory
2) Attempt any **three** questions from remaining questions
3) Assume suitable data wherever necessary and state it clearly
4) Figures to the right indicates maximum marks

Q1 **Attempt any five of the following** (20)

a) Compare abnormal combustion in SI and CI engines.
b) Sketch and explain actual port timing diagram for two stroke engine.
c) Give the reasons of black, blue and white colored smokes from exhaust of diesel engines.
d) Explain the effects of spark advancement and retardation on the engine performance.
e) Explain why turbo charged engines may have inferior values of power output and fuel consumption than naturally aspirated engines especially at low speed.
f) What are the components (at least four) of general diesel fuel injection system? State in brief function of each of them.

Q2 a) Describe the requirements for spark plug **(08)**

b) During test on a diesel engine the power developed by the engine is used for driving a DC generator with output of 210 ampere at 200 volt. The efficiency of generator is 82%. The fuel of 42600 kJ/kg calorific value is supplied to the engine at 11.2 kg/hr. The air fuel ratio was 18:1. The exhaust gases were passed through a exhaust gas calorimeter for which the observations were as follows: **(12)**

Water circulated through at 580 liters/hr, Temperature rise of water through calorimeter is equal to 36°C. Temperature of exhaust gases at exit from calorimeter is 98 °C. Ambient temperature is 20 °C.

Heat lost to jacket cooling water is 32% of the total heat supplied. If the specific heat of exhaust gases be 1.05 kJ/kg K, draw up the heat balance sheet on minute basis.

Q3 a) With neat sketch explain various types of fuel nozzles used in CI engine injection system **(10)**

b) A perfect gas at 1 bar and 290 K undergoes ideal diesel cycle. The maximum pressure of the cycle is 50 bar. The volume at the beginning of compression is $1m^3$ and after constant pressure heating is $0.1m^3$. Determine the temperature at all salient points of the cycle and also find out the efficiency of the cycle. Take $\gamma = 1.4$ for the gas. **(10)**

Q4 a) Compare air and water cooling systems **(08)**

b) A closed type injector has a nozzle orifice diameter of 0.9 mm and maximum cross sectional area of passage between needle cone and the seat is 1.75 mm^2. Coefficient of discharge for the orifice is 0.85 and for the passage is 0.8. The injection pressure is 175 bar and the average pressure of charge during injection is 25 bar, when the needle cone is fully lifted up. Calculate the volume rate of flow per second of fuel through the injector and the velocity of jet at that instant. Take density of fuel equal to 850 kg/m^3. **(12)**

Q5 a) Explain in detail the various stages of combustion in S.I. engine.
b) What is turbo charging? Describe in brief the methods of turbo charging. **(10)**

Q6 Write short note on (**any four**) **(20)**
a) Effect of dissociation phenomenon on PV diagram of Otto cycle
b) Control of NOx emission.
c) Alternate fuels in I.C. engines.
d) Stages of combustion in CI engine
e) Exhaust gas recirculation

MECH

QP Code : 3258

[1]

03 Hrs **[Total Marks 80]**

N.B.:

(1) **Question No.1 is compulsory**
(2) Attempt any **three** questions out 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) Explain generalized measurement system elements with block diagram. Describe its functions with suitable example. 10

(B) Classify control systems and explain the significance of transfer function in control systems 05

(C) Write short note on ON-OFF control system. 05

Q.2 (A) Explain the following terms with respect to the measurement system: (i) Accuracy (ii) Hysteresis (iii) Resolution (iv) Span and Range (v) Drift 05

(B) With a neat sketch explain the working of optical encoder

(C) Convert the following state-space system of a single input single output system into a transfer function: 10

$$\begin{Bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{Bmatrix} = \begin{bmatrix} -3 & 2 \\ 1 & 1 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} + \begin{Bmatrix} 0 \\ 2 \end{Bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix}.$$

Here x_1 and x_2 are state-variables, u(t) is a force vector and y(t) being the system response.

Q.3(A) With neat sketches discuss significance of followings aspects of signal conditionings for any one of the sensor: amplification, conversion filtering, modulation/demodulation, and grounding. 10

(B) The open loop transfer function of unity feedback system is 10

$$G(s) = \frac{K}{s(Ts+1)}$$

By what factor the gain 'K' should be multiplied so that damping ratio is increased from 0.3 to 0.8. By what factor time constant 'T' should be multiplied so that damping ratio is reduced from 0.6 to 0.4.

[PTO

Q.4 (A) Consider a single strain gage of resistance 120 Ω mounted along the axial direction of an axially loaded specimen of steel (E=200 GPa). If the percentage change in length of the rod due to loading is 3% and the corresponding change in resistivity of the strain gage material is 0.3%, estimate the percentage change in the resistance of the strain gage and its gage factor; Poisson ratio=0.3. If the strain gage is connected to a measurement device capable of determining change in resistance with an accuracy of ±0.02 Ω, what is the uncertainty in stress that would result in using this resistance measurement device? 10

(B) The forward transfer function of a unity feedback system is given by 10

$$G(S) = \frac{1}{(S^2 + 2S + 3)}$$

Using first principles

(i) Determine the position error and steady state error for a unit step input

(ii) Obtain the equation for close loop response in time domain C(t) due to step input

(iii) What is steady state error of close loop response for ramp and parabolic inputs?

Q.5(A) Sketch Bode plot and assess the stability for the control system having open loop transfer function 10

$$G(S)H(S) = \frac{120}{(S+2)(S+10)}$$

(B) With a neat sketch explain the constructional feature and working of (i) McLeod Gauge, (ii) Resistance thermometer 10

Q.6 (A) Draw the root-locus of the control system whose open-loop transfer function is given by

$$G(S)H(S) = \frac{K(S+4)(S+5)}{(S+3)(S+1)}$$ 10

(B) With a neat sketch explain the constructional feature and working of (i) digital tachometer, (ii) Magnetic flowmeter 10

ISEM V/ Production Process -II

MECH

29/05/2015

QP Code : 3265

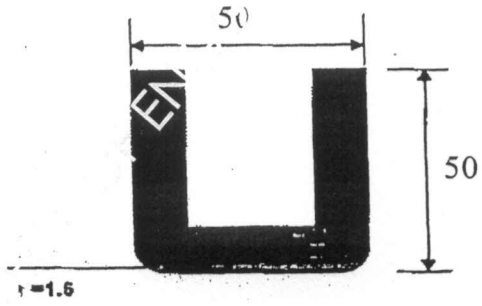
(3 Hours) **[Total Marks : 80**

N.B.: (1) Question **no. 1** is **compulsory**.
(2) Attempt **any Three** out of remaining **five**.
(3) Draw **neat and labeled** diagrams wherever required.

1. Attempt **any four** questions. **(5 marks each)** **20**
   (a) Explain the terms Fool proofing and swarf clearance
   (b) Write note on: Flexible manufacturing systems
   (c) Draw labelled diagram for compound die operation.
   (d) Differentiate between blanking and piercing with diagram.
   (e) What is HSM? Write applications and advantages of HSM.
   (f) Write a note on 'Diamond Pin',

2. (a) Find the total pressure and dimensions of die & punch sets to produce a washer of 6cm outside diameter with **2.6cm** diameter hole from material **3.7mm** thick, having shear strength **390 N/mm²**. Take clearance **9%** of stock thickness. **06**
   (b) Explain working of progressive die with diagram. **06**
   (c) Discuss all sheet metal operations with diagrams. **08**

3. (a) A symmetrical cup work-piece as shown in figure, is to be made from cold rolled steel **1.2mm** thick. Calculate the size of the blank,% reduction required, number of draws and drawing pressure. Take C=0.69, σ_{yt} = 450 N/mm² **08**



   (b) State and explain 'the principle of 3 - 2 - 1 location' with diagram **06**
   (c) Write a detail note on 'Ultrasonic Machining' **06**

4. (a) Discuss in detail general arrangement of an injection mold with feeding,cooling, runner, gate and ejection system. Draw neat labelled diagram. **10**
   (b) Write note on agile manufacturing and its integration into product-process development. Give suitable examples to elaborate your answer. **10**

[TURN OVER

5. (a) What are various clamping principles? and also explain working of any three types of clamps used in jigs and fixtures with diagram. 13

(b) Write note on : 10

(i) angular Jig

(ii) Indexing Fixtures

6. Write note on

(a) Locating Pins and Drill Bushes 7

(b) Electrochemical Machining 7

(c) Water Jet Machining 6

Course: T.E. (SEM.-V)(CBSGS) (MECHANICAL ENGG.) COMMON WITH (AUTOMOBILE ENGG.) (prog 665 TO 678)

Q.P Code: 3265

Correction:

Q.no.(3)(a)

Additional information:

Inside corner radius = 1.6 mm

Query Update time: 29/05/2015 03:00 PM

TE – II | Theory of Machines – II Mech (Rev)

13/05/15

QP Code : **3254**

(3 Hours) **[Total Marks : 80**

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

1. Answer any **four** questions :–
   (a) Why single plate clutches are dry whereas multi plate clutches are wet? **20**
   (b) Prove that sensitiveness of a pro ell governor is greater than that of porter governor.
   (c) Explain self-energizing and self-locking effect in block brake.
   (d) Explain the necessity of gear box in automobile.
   (e) Derive the expression to detennine gyroscopic couple.

2. (a) A leather faced conical clutch has a cone angle of 30°. If the intensity of pressure between the contact surfaces is limited to 0.35 N/mm^2 and the breadth of the conical surface is not to exceed one-third of the mean radius, find the dimensions of the contact surfaces to transmit 22.5 KW at 2000rpm. Assume unifonn rate of wear and take coefficient of friction as 0.15. **10**
   (b) In case of band and block there are 10 blocks. The coefficient of friction is 0.4. Each block subtends an angle of 16° with the centre of the wheel. The brake absorbs 225 Kw at 300 rpm. The effective diameter is 80 em. Find the force applied at the end of lever 25 em long if band is attached at a distance of 15 em and 3 em either side of the fulcrum. **10**

3. (a) In the epicyclic gear train shown in Fig. 1, a gear C which has teeth cut internally and externally is free to rotate on an arm driven by the shaft S_1. It meshes externally with the casing D and internally with the pinion B. The gears have following number of teeth: T_B.=24, T_c=32 and T_d=48, Find the velocity ratio between (i) S_1 and S_2 when D is fixed. **12**

[TURN OVER

(ii) S_1 and D when S_2 is fixed. What will be the torque required to fix the casing D if a torque of 300Nm is applied to shaft S_1?

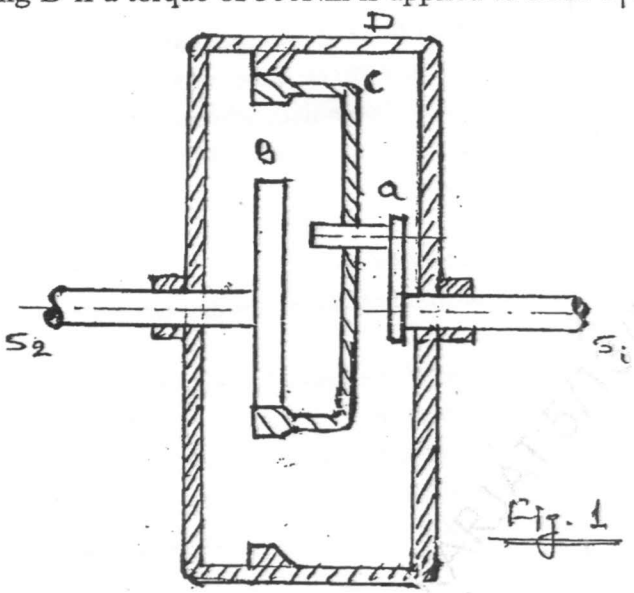


Fig. 1

(b) Derive an expression for finding 'angle of heel' of a two wheeler negotiating a tum. **8**

4. (a) A horizontal gas engine running at 210 rpm has a bore of 220mm and a stroke of 440mm. The connecting rod is 924mm long and the reciprocating parts weight 20Kg. when the crank has turned through an angle of 30° from the inner dead center, gas pressure on the cover and the crank sides are 500KN/m^2 and 60KN/m^2 respectively. Diameter of the piston rod is 40mm. Determine (i) turning moment on crank shaft. (ii) thrust on the bearing. (iii) acceleration of the flywheel which has a mass of 8 Kg and radius of gyration of 600mm while the power of engine is 22Kw. **12**

(b) Single plate clutch transmits 25 Kw at 900rpm. The maximum pressure intensity between the plates is 85KN/m^2. The outer diameter of the plate is 360mm. Both sides of the plate are effective and the coefficient of friction is 0.25. **8**

Determine the (i) Inner diameter of the plate (ii) Axial force to engage the clutch

[TURN OVER

5. (a) The arms of Hartnell governor are of equal length. When the sleeve is in the mid position, the masses rotate in a circle with diameter of 150mm (the arms are vertical in the mid position). Neglecting friction, the equilibrium speed for this position is 360rpm. Maximum variation\ of speed taking friction into account, is to be 6% of the mid position speed for a maximum sleeve movement of 30mm. The sleeve mass is 5 Kg and the friction of sleeve is 35N. Assuming that the power of the governor is sufficient to overcome the friction by 1% change of speed on each side of mean position. Find (neglecting obliquity effects of the arms), the (i)mass of each rotating of ball. ii) spring stiffness. iii) initial compression of the spring. **12**

(b) State the different types of governors. What is the difference between centrifugal and inertia governors? Why is the former preferred to the later? **8**

6. (a) Each wheel of four wheeled rear engine automobile has a moment of inertia 2.4 Kg m^2 and an effective diameter of 660mm. The rotating parts of the engine have a moment of inertia of 1.2Kg m^2. The gear ratio of engine to the back wheel is 3 to 1. The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The mass of vehicle is 2200Kg and the centre of the mass is 550mm above the road level. The track width of the vehicle is 1.5m. Determine the limiting speed of the vehicle around a curve with 80m radius so that all the four wheels maintain contact with the road surface. **10**

(b) A riveting machine is driven by a constant torque 3KW motor. The moving parts including the flywheel are equivalent to 150Kg mass and 0.6m radius. One riveting operation takes one second and absorbs 10000 N-m of energy. The speed of flywheel is 300 rpm before riveting. How many rivets can be closed per minute? **10**
