TE - VI | Heat Transfer | 10-12-14 MECH

QP Code : 14964

(3 Hours) [Total Marks : 80

Instructions:

1) Question No 1 is compulsory
2) Answer any 3 from the remaining.
3) Assume suitable data if necessary.

Q-1 Answer any 4 questions. 20

a) A rectangular slab (k = 10 W/m-K) of thickness 15 cm and inside temperature of 400°C is insulated by a materials of thickness 10 cm (K = 30W/m-K). The ambient air is at 28°C and the outside convective heat transfer coefficient is 15 W/m^2K. Determine the steady state heat transfer per unit surface area and the temperature of outside surface of the slab and the insulation.

b) In an oil cooler, oil (m=2500kg/hr and C_p = 1.9 kJ/kg-K)) at 160°C is cooled by water(m=1500 kg/hr and C_p =4.187 kJ/kg-K) entering at 35°C. Determine Capacity ratio, NTU and effectiveness if the overall heat transfer coefficient is 300 W/m^2K. Assume parallel flow.

c) A pipe, 2cm diameter, at 40°C is placed in (i) an air flow at 50°C with h = 20W/m^2K OR in (ii) water at 30°C with h = 70W/m^2K. Find the heat transfer per unit length of the pipe and comment on the results in both cases.

d) Define Fin efficiency and Fin effectiveness. Explain in brief factors affecting fin effectiveness.

e) What is the mode of heat transfer in Vacuum? Define absorptivity, reflectivity and transmissivity.

Q-2 a) Water (mass = 1.4 kg/s , C_p = 4.187KJ/kg-K) is heated from 40°C to 70°C by an oil (mass = 2 kg/sec, C_p =1.9 KJ/kg-K) entering at 110 °C in a counter flow heat exchanger. If overall heat transfer coefficient is 350 W/m^2K, calculate the surface area required. 10

b) Derive the temperature profile equation for a cylindrical system from the general differential equation stating the assumptions for one dimensional steady state heat transfer. 10

Q-3 a) A steel pipe of OD 0.15m lies 2m vertically and 8m horizontally in a large room with an ambient temperature of 30°C. The pipe surface is at 250°C and has an emissivity of 0.6. Estimate the total heat loss (due to convection and radiation) from the pipe to the atmosphere. Properties at film temperature : $v = 27.8 \times 10^{-6}$ m^2/s, k =0.035 W/mK, Pr =0.684. 10
[Take Nu =0.13 $(Gr.Pr)^{1/3}$ if the flow is turbulent OR Nu =0.53 $(Gr.Pr)^{1/4}$ if the flow is Laminar.]

b) What is lumped system analysis? When is it applicable? 4

c) Draw a neat boiling curve for water and mark the different regions. 6

Q-4 a) A furnace door, 1.5 m high and 1m wide is insulated from inside and has an outer surface temperature of 70°C. If the surrounding ambient air is at 30°C calculate steady state heat loss from the door. Take the properties from at film temperature 50°C are ρ= 1.093$Kg.m^3$, v =17.95 x 10-6 m^2/s, Pr =0.698 Cp = = 1.005J/kg-K, use the correlation Nu =0.13 $(Ra)^{1/3}$ 10

b) A longitudinal copper fin (k=380W/m-K) 600 mm long and 5 mm diameter 6

TURN OVER

is exposed to an air stream at 20°C. The convective heat transfer coefficient is 20 W/m^2-K. If the fin base temperature is is 150°C, determine the rate of heat transfer and Fin efficiency.

c) How a radiation network is is constructed between two grey surfaces exchanging radiant heat energy? 4

Q-5 a) With the help of Buckingham π-theorem show that for a forced convection $Nu = C\ Re^m\ Pr^n$. 8

b) An 8 cm diameter Orange, approximately spherical in shape, undergoes ripening process and generates 5000$W/m^3$of energy. If the external surface of the orange is at 6.5°C calculate the temperature at the center and also find the heat flow from the outer surface. Take k =0.22W/m-K for the orange. Assume steady state heat transfer. 6

c) A 3.2 mm stainless steel wire, 30 cm long has a voltage of 10 Volt impressed on it. The outer surface temperature of the wire is maintained at 93°C. Calculate the center temperature of the wire. Take resistivity (ρ) of the wire as 70 x 10^{-8} ohm-m and the thermal conductivity as 22.5 W/mK. 6

Q-6 a) 10 mm OD pipe carries a cryogenic fluid at 80K. This pipe is encased by another pipe of 15mm OD, and the space between them is evacuated. The outer pipe is at 280K. Emissivity of inner and outer surfaces is 0.2 and 0.3 respectively. (i) Determine the radiant heat flow rate over a pipe length of 5m. (ii)If a radiation shield of diameter 12mm and emissivity 0.05 on both sides is placed between the pipes, determine the percentage reduction in heat flow. (iii) What is the equilibrium temperature of the shield? 10

b) A spherical tank, 1 m in diameter is maintained at a temperature of 120°C and exposed to a convection environment with h = 25W/m^2-K and temperature of ambient is 15°C. What thickness of urethane foam (k = 20 x 10^{-3} W/m-K) should be added to ensure that the outer temperature of the insulation does not exceed 40°C? What percentage reduction in heat loss results from installing this insulation? 6

c) Define effectiveness and NTU of a heat exchanger. 4

— x —

GN-Con. 10996-14.

Course : T.E.(MECHANICAL & AUTOMOBILE)(SEM V)(CBSGS)(PROG 537 TO 549)

Q.P Code : 14964

Correction :

READ

Ques. No. 1(b) Area = 1 sq.m

Ques. No. 4 (a)

1. Cp= 1.005KJ/Kg-K **instead of** Cp== 1.005 J/Kg-K
2. v =17.95 x 10^{-6} m^2/s **and** k =0.02826 W/mK

Query Update time : 10/12/2014 04:00 pm

TE - V / Mech / Mechanical Measurement & Control

24-11-2014 (MECH)

K.G.C.E. EXAM KARJAT, RAIGAD

QP Code :14846

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) Following table list the measuring instruments (left hand side column of the table) for measuring mechanical properties (right hand side column of the table) of the system. Students shall match the measuring instrument with the corresponding mechanical property. 04

Measuring Instruments	Properties
Optical pyrometer	Temperature
McLeod gauge	Speed
Rotameter	Pressure
Stroboscope	Flow rate

Further student shall explain only the working principle of the measurement instrument listed on left hand side column of the table. 04

(B) Construct the block diagram that combines the following set of equations expressed in the 's' notation (Laplace notation). (1) W=X-Y, (2) V=W-Z, (3) Z(S+6)=V(S+2), (4) $Y(S^2+6S+8)=Z$. Given X is the input to the system and Y is the output from the block diagram. Find the transfer function. 06

(C) Write short note on proportional-integral-derivative (PID) controller. 06

Q.2 (A) Explain the following terms with respect to the measurement system: 05

(i) Threshold and Resolution

(ii) Sensitivity and Drift

(iii) Hysteresis

(B) With a neat sketch explain the working of LVDT 05

(C) Consider the following state-space representation of single input single output system: 10

$$\begin{Bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{Bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -3 & -2 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \\ x_3 \end{Bmatrix} + \begin{Bmatrix} 0 \\ 0 \\ 1 \end{Bmatrix} u(t) \text{, and } y(t) = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \\ x_3 \end{Bmatrix}.$$

Here x_1, x_2 and x_3 are state-variables, u(t) is a force vector and y(t) being the system response. Obtain transfer function of the system.

[TURN OVER

Q.3(A) With a neat sketch explain the constructional feature and working of (i) piezoelectric accelerometer, (ii) Ionization gage for pressure measurement 10

(B) Figure 1 shows the unit step response of a second order system. 10
Determine the following from the plot
(i) Gain
(ii) Damping ratio
(iii) Natural Frequency
(iv) Transfer function

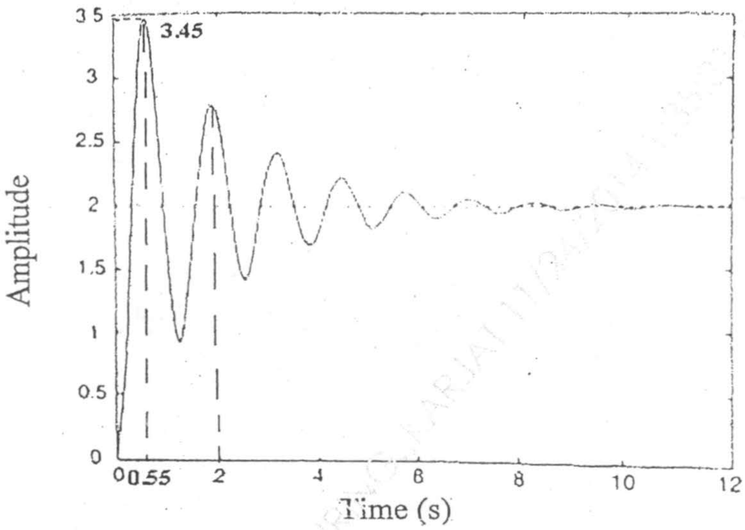

Figure 1

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) For a control system open loop transfer function consist of 10

$$G(s)\,H(s) = \frac{K}{S^2(S+2)(S+3)}.$$ Find the value of "K" to limit steady state error to 10, when input to system is $\{1 + 10t + 20t^2\}$. Here 't' is the time.

[TURN OVER

Q.5(A) For a particular unity feed-back system 10

$$G(S) = \frac{242(S+5)}{S(S+1)(S^2+5S+121)}$$

Sketch a Bode plot. Further comment on stability of the system

(B) With a neat sketch explain working of an Operational Amplifier (Op-amp). Enumerate limitations of the same. 10

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

$$G(S)H(S) = \frac{K}{S^2(S+1)}$$ 10

(B) Explain generalized measurement system elements with block diagram. Describe its functions with suitable example. 10

TE - V / Mech / Mechanical Measurement & Control

24-11-2014 (MECH)

K.G.C.E. EXAM KARJAT, RAIGAD

QP Code :14846

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[TURN OVER

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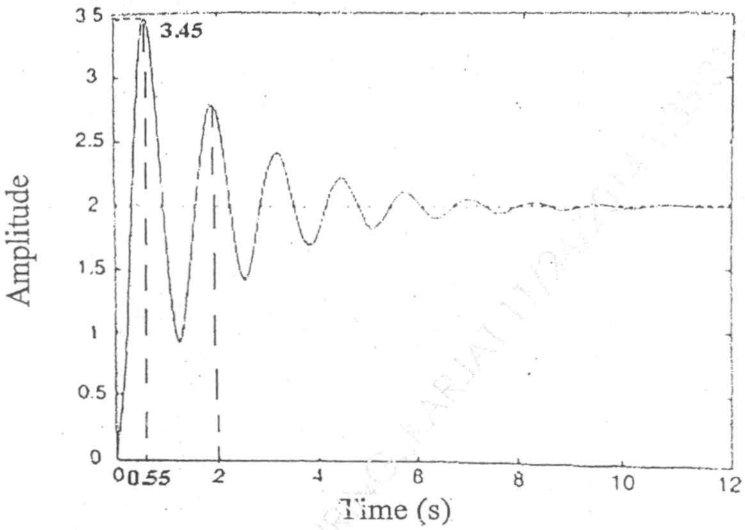

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TE - II | Production Process - III | MECH

04-12-14

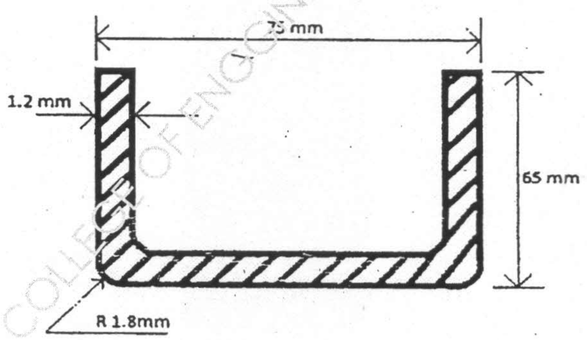
QP Code : **14924**

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

N.B : (1) Question **No.1** is **compulsory**.
(2) Attempt any **three** questions from remaining **six** questions.
(3) **Assume** suitable **data** if required.
(4) **Figures** to the **right** indicate **full** marks.

1. Write about any **five** :— **20**
   (a) Working of Screw Type Injection Molding.
   (b) Principle and basic process parameters of Water Jet Machining.
   (c) Applications of various types of Bushes used in jigs.
   (d) Flexible Manufacturing Systems.
   (e) Compound Die construction with sketch.
   (f) Types of Automats.

2. (a) A symmetrical cup work-piece is shown in the figure. It is to be made from cold rolled steel, 1.2 mm thick. Make necessary calculations for designing the drawing die for this component. Determine the size of blank, percentage reduction, number of draws required, radius of punch and die, Drawing pressure if $\sigma_{yt} = 430$ N/mm^2. Take C = 0.67. **10**



   (b) What is Laser Beam Machining? Show its construction, working and applications with the help of diagram. **10**

3. (a) Write about the different types of Runners and Gates used in Plastic Injection Molds with the help of diagrams. **10**
   (b) What are jigs used for? Show with the help of diagrams, the working of Pot jig, Box jig, Plate jig and Turnover jig. **10**

[TURN OVER

QP Code : **14924**

4. (a) How is the 3-2-1 Location principle used for designing of Jigs and Fixtures? 5
   (b) How are Transfer lines used in mass manufacturing? Also give its classification. 5
   (c) What is agile manufacturing? Show its need in the manufacturing industry. 10

5. (a) What is EDM? Write about its applications, advantages and limitations. 5
   (b) Why is ejection system used in plastic injection molds? Write about Pin ejection method using a neat sketch. 5
   (c) Write about the construction and working of progressive die and combination die with the help of neat sketches. 10

6. (a) Write in detail about clamping and locating devices used in jigs and fixtures. 10
   (b) How is Indexing mechanism used in fixtures? Show working of a sliding indexing fixture with the help of a diagram. 5
   (c) How is classification of Non-traditional Machining done? Show the classification using a chart. 5

Sem-V / Theory of machines-II / mech / 18-11-14

K.G.C.E. EXAM KARJAT, RAIGAD

Q.P. Code : 14809

(3 Hours) [Total Marks : 80

N.B. : (1) Question No. 1 is compulsory.
(2) Attempt any three questions out of the remaining five.
(3) Assume suitable data if necessary but justify the same.
(4) Figures to the right indicate full marks.

Q1. Attempt any four (20)

A. How does a clutch differ from that of a brake?

B. Explain the controlling force diagram for a spring controlled governor.

C. Derive the equation for the gyroscopic couple on a naval ship during pitching.

D. What do you mean by gear train? List down all the types of gear train and give one application of each.

E. Determine the minimum value for the radius ratio R_2 / R_1 of a single plate clutch at which the capacity of clutch will decrease by not more than 10 % during the initial wear period.

Q2 A. A plate clutch has three discs on the driving shaft and two discs on the driven shaft. The inside and the outside diameters of the friction surfaces are 125 mm and 250 mm respectively. Assuming uniform pressure and coefficient of friction equal to 0.3, find the total spring load pressing the plates together to transmit 30 kW at 1500 rpm. (7)

B. A simple band brake is applied to a shaft carrying a flywheel of mass 250 kg and radius of gyration 300 mm. The shaft speed is 200 rpm. The drum diameter is 200 mm and the coefficient of friction is 0.25. The free end of band is attached at 100 mm from the fulcrum and effort of 120 N is applied on lever at 280 mm on the other side of the fulcrum. The angle embraced by belt is 225^0. Determine for counter clockwise rotation of drum i) Braking torque ii) The number of turns of flywheel before it comes to rest. (7)

C. What do you mean by a dynamometer? Classify the same. How does a dynamometer differ from a brake? (6)

Q3 A. For a spring controlled Hartnell type governor, following data is provided:- (7)
Mass of the governor ball = 1.80 kg
Length of the vertical arm of the bell crank lever = 8.75 cm
Length of the other arm of bell crank lever = 10 cm
The speeds corresponding to radii of rotations of 12 cm and 13 cm are 296 and 304 rpm respectively. Determine the stiffness of the spring.

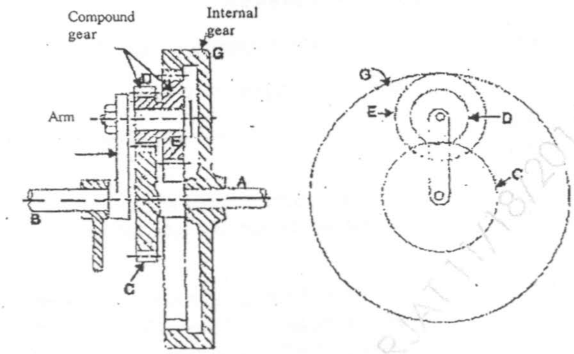
B. A solid circular steel disc 250 mm diameter and 50 mm thick is mounted with its polar axis on the line OX, of the three Cartesian axes OX, OY and OZ. If at a particular instant the disc is spinning about OX at 12 rad/sec in anticlockwise direction when viewed from right hand side and the frame is rotated at 5 rad/sec about OY in anticlockwise direction when viewed from top, determine the magnitude and sense of the gyroscopic couple. Density of the steel may be taken as 7.8 gm/cc. (7)

C. With the help of neat sketch explain the following terms with respect to gyroscope i) Spin plane ii) Precession axis iii) Gyroscopic plane (6)

TURN OVER

MECH

Q4 A. Two shafts A and B are co-axial. A gear C having 50 teeth is rigidly mounted on shaft A. A compound gear D-E gears with C and an internal gear G. D has 20 teeth and gears with C and E has 35 teeth and gears with an internal gear G. The gear G is fixed and is concentric with the shaft axis. The compound gear D-E is mounted on a pin which projects from an arm keyed to the shaft B. Find the number of teeth on the internal gear G assuming that all the gears have the same module. If the shaft A rotates at 110 rpm find the speed of the shaft B. (7)



B. A riveting machine is driven by a constant torque 3 kW motor. The moving parts including the flywheel are equivalent to 150 kg at 0.6 m radius. One riveting operation takes 1 second and absorbs 10000 N-m of energy. The speed of the flywheel is 300 rpm before riveting. Find the speed immediately after riveting. How many rivets can be closed per minute? (7)

C. Derive the equation for the correction couple to be applied to make two mass systems dynamically equivalent. (6)

Q5 A. The turning moment diagram for a four stroke gas engine may be assumed for simplicity to be represented by four triangles, the areas of which from the line of zero pressure are as follows: (10)
Suction stroke = 0.45×10^{-3} m^2; Compression stroke = 1.7×10^{-3} m^2; Expansion stroke = 6.8×10^{-3} m^2; Exhaust stroke = 0.65×10^{-3} m^2. Each m^2 of area represents 3 MN-m of energy. All the areas except expansion stroke are negative. Assuming the resisting torque to be uniform, find the mass of the rim of a flywheel required to keep the speed between 202 and 198 rpm. The mean radius of the rim is 1.2 m.

B. A centrifugal clutch transmits 20 kW of power at 750 rpm. The engagement of the clutch commences at 70 % of the running speed. The inside diameter of the drum is 200 mm and the distance of the centre of the mass of each shoe is 40 mm from the contact surface. Determine the (10)
i) mass of each shoe
ii) net force exerted by each shoe on the drum surface
iii) power transmitted when the shoe is worn 2 mm and is not readjusted.
Assume μ to be 0.25, number of shoes equal to 4 and the stiffness of the spring 150 kN/m.

[TURN OVER

MECH

Q6 A. A Porter governor has equal arms each 250 mm long and pivoted on the axis of the rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the range of the speed, sleeve lift, governor effort and power of the governor in the following cases :- (10)

i) when the friction at the sleeve is neglected, and
ii) when the friction at the sleeve is equivalent to 10 N.

B. An over drive for a vehicle consists of an epicyclic gear train as shown in the figure, with compound planets B-C. B has 15 teeth and meshes with an annulus A which has 60 teeth. C has 20 teeth and meshes with the sunwheel D which is fixed. The annulus is keyed to the propeller shaft Y which rotates at 740 rad/sec. The spider which carries the pins upon which the planets revolve, is driven directly from main gear box by shaft X, this shaft being relatively free to rotate with respect to wheel D. Find the speed of shaft X, when all the teeth have the same module. (10)