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Total No. of Pages : 7

Seat No.	

T.E. (Mechanical) (Semester - V) (Revised) Examination, May - 2015
CONTROL ENGINEERING
Subj. Code : 48709

Day and Date : Thursday, 28 - 05 - 2015 Total Marks : 100

Time : 2.30 p.m. to 05.30 p.m.

Instructions : 1) Question No 1 and 5 are compulsory. Solve any two questions from remaining in Each section

2) Assume suitable data wherever necessary and state it clearly

3) Figures to the right indicate full marks

4) Draw neat sketches wherever necessary

SECTION - I

Q1) a) Draw the block diagram of a speed control of steam engine system indicating the function of each element. [6]

b) Show that the two systems shown in Fig 1(b) are analogous systems, by comparing their transfer functions. [6]

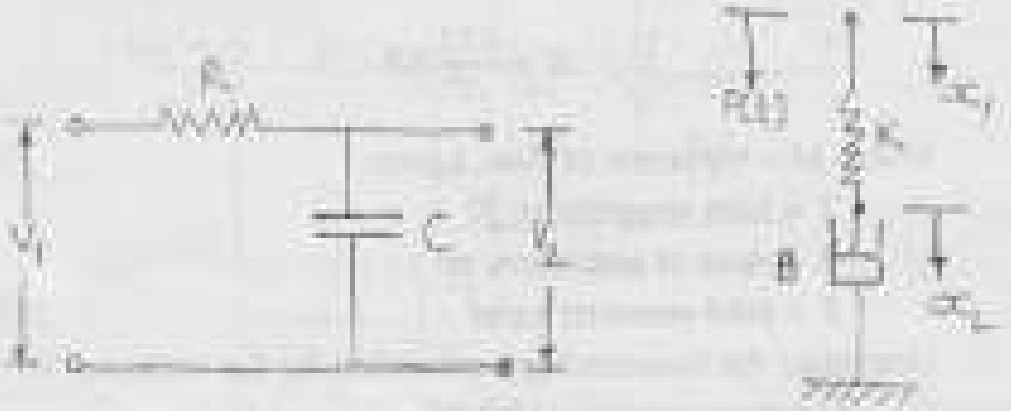


Fig. 1 (b)

P.T.O.

c) Consider Rotational system shown in Fig 1(c) [6]

where J = Moment of inertia of disk

B = Friction constant

K = Torsional spring constant

and disk subjected to torque T(t).

Draw its analogous network based on

(i) F-V analogy (ii) F-I analogy

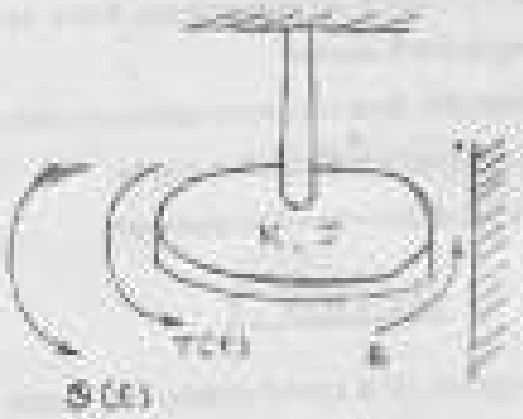


fig - 1(c)

Q2) a) Derive the differential equation which relates input and output motion of hydraulic servomotor, for steady state operation. [8]

b) For sonic flow of air through a fixed restriction, the mass rate of flow is [8]

$$M = \frac{0.53}{\sqrt{T}} AP$$

Where M = Mass rate of flow, kg/sec

T = Inlet temperature, K

A = Area of restriction, m^2

P = Inlet pressure, kg/m^2

Determine the linearized approximation for the variation 'm' when

i) Inlet temperature is constant

ii) Inlet pressure is constant

iii) Both inlet temperature and pressure constant

Q3) a) The steady - state operating curves for a system to be controlled are shown in Fig 3(a). The reference operating condition is $V_r = C_r = 500$, $U_r = 100$ and $M_r = 200$. Determine the slope of the controller lines such that the controlled variable does not decrease by more than 4 percent of its reference value ($C = 0.04 \times 500 = 20$) when U = 125. [8]

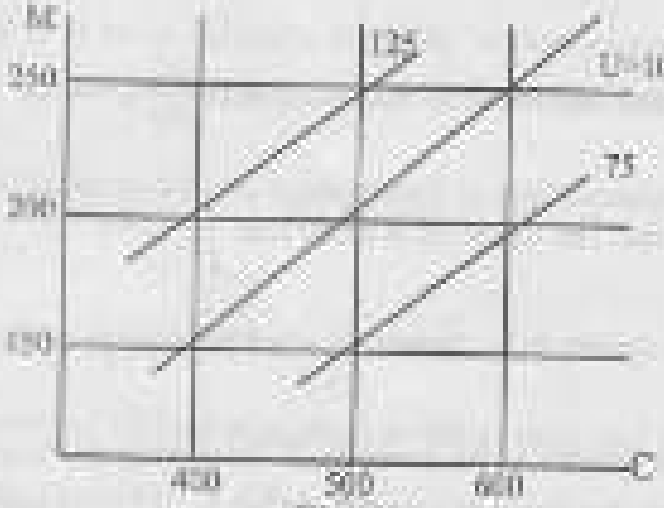


Fig 3(a)

b) Reduce the given block diagram shown in Fig 3(b) and then obtain the transfer function of the system if $G_1 = G_3 = 1$, $G_2 = G_4 = 2$ and $H_1 = H_2 = 1$, $H_3 = 2$. [8]

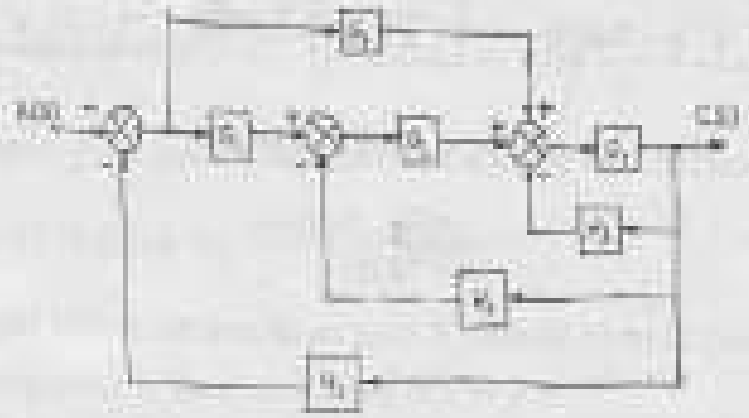


fig 3(b)

Q4) a) The block diagram of a feedback control system for operation about a reference operating point is shown in Fig 4(a). The steady state equation of operation is [8]

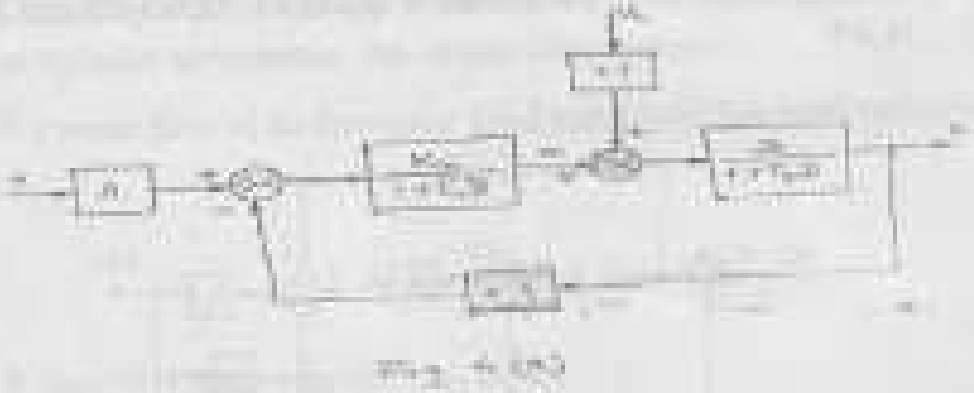
$$C = \left.\frac{\partial C}{\partial V}\right|_0 V + \left.\frac{\partial C}{\partial U}\right|_0 U$$

i) Determine the value of KG such that $\left.\frac{\partial C}{\partial U}\right|_0 = 0.05$

ii) Determine the value of K such that $\left.\frac{\partial C}{\partial V}\right|_0 = 1$

iii) For the system to be controlled, what is the slope of the lines of constant U ?

iv) For the system to be controlled, determine the horizontal spacing ΔC between the lines of constant U when $\Delta U = 10$ units



b) Derive the transfer function relations for AC and DC tachometers [8]

SECTION - II

(05) a) The loop transfer function of a unit feedback control system is

$$G(s)=\frac{K}{s^3+3s^2+8s-7}$$

Draw the root locus diagram, mark the salient points and determine the range of K for a closed loop system to be stable. [9]

b) A second order system is represented by the transfer function. [9]

$$\frac{C(s)}{I(s)}=\frac{1}{Js^2+fs+K}$$

A step input of 10 NM is applied to the system and the test results are

i) Maximum overshoot = 6%

ii) Time at peak overshoot = 1sec

iii) The steady state value of the output is 0.5 radians Determine the values of J, f and K

(06) a) Obtain the transfer function G(s) for the following output and state space equations: $y(t)=x_1$, $\frac{dx_1}{dt}=-3x_1+x_2$ and $\frac{dx_2}{dt}=-2x_2+u(t)$ [8]

b) The open loop transfer function of a unity FBCS(Feed Back Control System) is given by $G(s)=\frac{K}{s(s^2+1)}$ [8]

i) By what factor the amplifier gain K should be multiplied so that damping ratio is increased from 0.2 to 0.8

ii) By what factor the time constant T should be multiplied so that the damping ratio is reduced from 0.6 to 0.3.

(Q7) a) A control system having, [8]

$$G(s)=\frac{K(S^2-2S+5)}{(S+2)(S-0.5)} \text{ and } H(s)=1$$

Find

i) Break away points

ii) Maximum and minimum values of K for stability

iii) Cross over frequency

iv) Angle of arrival

b) Determine the computer diagram and state space model for a transfer function of the system as [8]

$$\frac{Y(S)}{R(S)}=\frac{2S+9}{S^3+8S^2+12S+10}$$

use direct programming method

(Q8) a) A unity feedback system has $G(s)=\frac{K(s+13)}{s(s+3)(s+7)}$. Using Routh's Criterion calculate the range of K for which the system is

i) Stable

ii) has its closed loop poles more negative than - 1 [8]

b) Determine the state space model and computer diagram for feedback control system shown in Fig 8(b) [8]

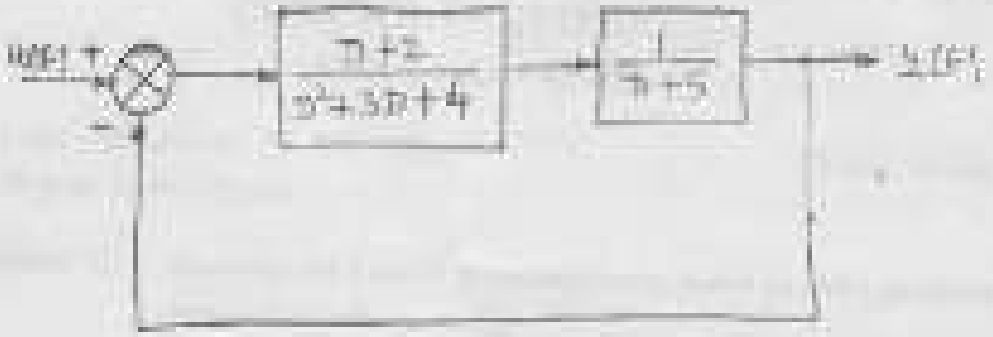


Fig 8(b)

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Seat No.	

T.E. (Mech.) (Part - III) (Semester - V) Examination, May - 2015

HEAT AND MASS TRANSFER

Sub. Code : 45550

Day and Date : Thursday, 21 - 05 - 2015 Total Marks : 100

Time : 02.30 p.m. to 05.30 p.m.

Instructions: 1) Solve any three questions from Section - I & Section - II each.

2) Assume suitable data if necessary and mention it clearly.

3) Figures to the right indicate full marks.

SECTION - I

Q1) a) Derive the expression for critical radius of insulation for cylinder. [6]

b) Thermal conductivity of plane wall varies with temperature according to relation $k(T) = k_0 (1 + \beta T^2)$ where k_0 and β are constants. Develop an expression for heat flow through slab per unit area if surface at $x = 0$ and $x = L$ are maintained at uniform temperatures T_1 and T_2 respectively. Hence calculate the heat transfer rate through $A = 0.1 m^2$, $T_1 = 200°C$, $T_2 = 0°C$, $L = 0.4m$, $k_0 = 60 \ W/m°C$, $\beta = 0.25 \times 10^{-4} \ °C^{-2}$. [10]

Q2) a) Write the general heat conduction equation in cylindrical coordinates and hence derive the relation for temperature distribution in long hollow cylinder with heat generation rate (Q̇) with inside outside temperatures as T_1 and T_2 respectively Take r_1 and r_2 as inside and outside radii [8]

b) A pin fin of 2.5 cm diameter is provided on surface exposed to air at 27°C. After a steady state the temperatures at two points 7.6 cm apart were found to be 126° C and 91°C respectively. The heat transfer coefficient over the surface of fin is 22.7 $W/m^2 K$. What is the thermal conductivity of fin material? [8]

P.T.O.

Q3) a) A thermocouple junction is in the form of 4mm sphere. Properties of material are $c_p = 420\ J/kgK$, $\rho = 8000\ kg/m^3$, $k = 40\ W/mK$ and $h = 45\ W/m^2K$. Junction is initially at temperature of 28°C and inserted in hot air stream at 300°C for 16 seconds. It is taken out after 10 seconds and kept in still air at 30°C with $h = 10\ W/m^2K$. Find the temperature attained by the junction 15 seconds after removing from hot air stream. [10]

b) Discuss Planck's law for spectral distribution. [8]

Q4) a) The temperature of black body of area 0.1m² is 900K. Calculate the total rate of energy emission, intensity of normal radiation in $\left[W/m^2sr\right]$ maximum monochromatic emissive power and wavelength at which it occurs. Given : $C_2 = 1.287 \times 10^{-4}$ [8]

b) The net radiation from the surface of two parallel plates maintained at temperature T_1 and T_2 is to be reduced by 75 times. Calculate number of shields to be placed between two surfaces if emissivity of shield is 0.05 and that of surfaces is 0.8. [8]

SECTION - II

Q5) a) Give the significance of reference temperature in convective heat transfer. What is mean film temperature bulk mean temperature? [8]

b) Liquid mercury flows through a copper tube of 2 cm inner diameter at the rate of 1.25 kg/s. The mercury enters at 15°C & is heated to 25°C as it passes through the tube. Determine the tube length which would satisfy the condition of a constant heat flux at the wall which is at an average temperature of 40°C.

For liquid metals, the following correlation is presumed to agree well with experimental results.

$Nu = [7 + 0.025\ (pe)^{0.8}]$

Where, 'pe' is the peclet number ; $pe = (pr \times Re)$ at the mean bulk temp.,

$$tb = \frac{15 + 25}{2} = 20^\circ C,$$

The thermo-physical properties of the liquid mercury are, $\rho = 13288 kg/m^3$; $K = 8.685\ w/m.k$; $Cp = 139.35 kg.k$ $\gamma = 1.145 \times 10^{-7}\ m^2/s$, $4\ pr = 0.0349$. [8]

(Q6) a) Discuss the mechanism of convective heat transfer in detail. Give Newton's law of heating cooling. What is heat transfer coefficient? [8]

b) A horizontal cylindrical heat exchanger of shell diameter 40cm and surface temperature 124°C is to be cooled by ambient air at 30°C. Workout the convective coefficient and the rate of heat loss from unit surface area of the heat exchanger. Use the correlation, Nu = 0.54 (Gr.Pr)0.25. Properties of air at mean film temperature are;

$\gamma = 20.76 \times 10^{-6}$ m²/s; k = 0.03003 w/m.k & pr = 0.697. [8]

(Q7) a) Derive an expression for effective of counterflow heat exchanger. [8]

b) 45 kg/hr of water is to be heated from 10°C to 70°C with flue gases having an initial temperature at 160°C. The mass flow rate of the flue gases is 170 kg/hr. The specific heat of flue gas is 1.05 $^{kJ}/_{kg\,k}$. The overall heat transfer coefficient may be taken as 114 W/m².k.

Calculate the heat transfer area required for counterflow type heat exchanger.

Assume specific heat of water as 4.18 kJ/kg.k. [8]

(Q8) Write short notes on (Any Three): [18]

a) Fick's law of diffusion

b) Heat pipe

c) Condensation & its types

d) Forced convection boiling

e) LMTD correction factor

f) Fouling & its types

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Total No. of Pages : 4

Seat No.	

T.E. (Mech.) (Part - III) (Semester - V) Examination, May - 2015

MACHINE DESIGN - I

Sub. Code : 45551

Day and Date : Tuesday, 26 - 05 - 2015 Total Marks : 100

Time : 2.30 p.m. to 5.30 p.m.

Instructions : 1) Attempt any three questions from each section.
2) Figures to the right indicates full marks.
3) Draw sketches if required.
4) Assume suitable data & mention the same clearly.

SECTION - I

Q1) a) Explain in brief factors govern the selection of material for mechanical component. [6]

b) What is factor of safety? Why it is used in Machine design? [5]

c) Suggest suitable material for following components giving the reasons. [6]

i) Automotive cylinder block.
ii) Gears
iii) Flange for coupling.

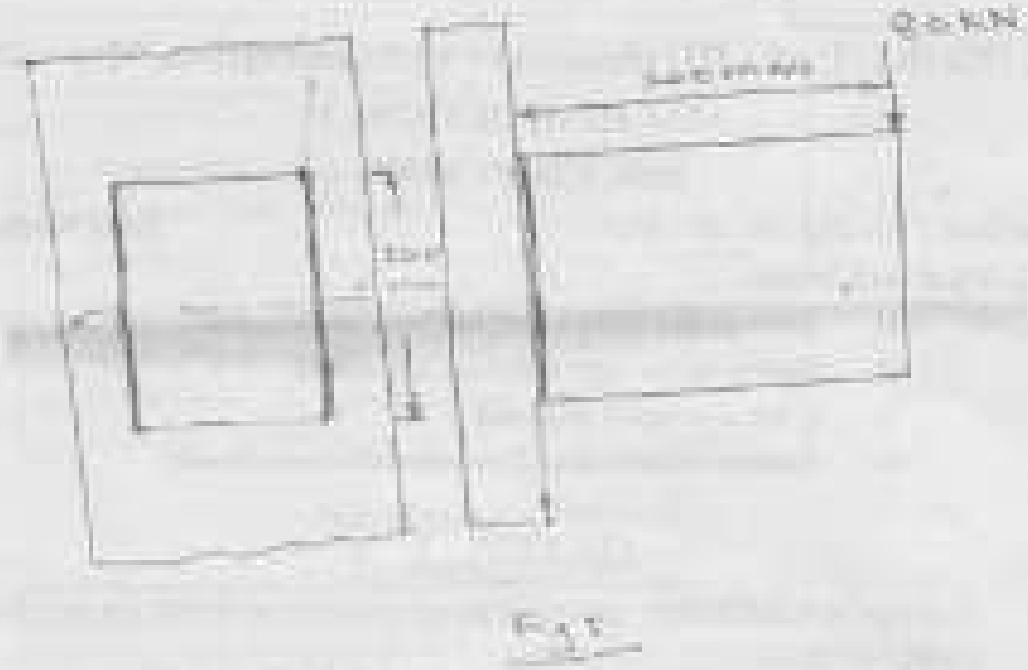
Q2) a) Explain design procedure of Knuckle joint with the help of neat sketch. [7]

b) Design a right angled bell crank lever having one arm 500 mm and other 200 mm long. The load of 6 kN is to be raised acting on long mm end by appling effort at short arm end. The permissible stresses for lever and pin are 80 Mpa in tension and 60 Mpa in shear. The bearing pressure is limited to 12N/mm^2. The lever is rectangular in cross -section. Assume depth of lever is three times the thickness and the pin length is 1.25 times pin diameter. [10]

Q3) a) Describe the design procedure of bolts subjected to eccentric loading acting perpendicular to the axis of bolts. [7]

b) A bracket is welded to the vertical plate by means of two fillet welds as shown in figure. Determine the size of welds, if permisible shear stress is limited to 100 N/mm^2. [9]

P.T.O.



Q4) a) A mild steel shaft is required to transmit 100 kW at 500 rpm. The supported length of shaft is 4.5 meters. If carries two pulleys each weighing 1200 N supported at a distance of 1.5 meter from the ends respectively. Determine the diameter of shaft if safe shear stress for shaft material is 70 N/mm^2. [10]

b) Explain design procedure of muff coupling with neat sketch. [6]

SECTION - II

Q5) a) Derive equation for combined stiffness if number of springs are used in series and parallel. [6]

b) Design helical compression spring for maximum load of 2000 N for deflection of 20 mm. Take spring index as 5 permissible shear stress is 400 N/mm^2 and modules of rigidity 84×10^3N/mm^2
Refer table for wire selection. [10]

SWG	40	30	20	0	1
Wire dia mm	10.160	9.490	8.839	8.229	7.620

(Q6) a) Explain self locking & overhauling properties of power screw. [6]

b) Square threaded screw exerts load of 50 kn with nominal diameter of 100 mm and pitch of 12 mm. Height of nut is 150 mm. Coefficient of friction between screw & nut is 0.15.

Find

i) Force required at end of rim of 300 mm diameter.

ii) Maximum shear stress

iii) Transverse shear stress

iv) Bearing pressure

v) Efficiency of Screw [10]

(Q7) a) Explain coefficient of fluctuation of energy in case of flywheel. [7]

b) Two stroke petrol engine develops 15 KW @ 500 RPM. Coefficient of fluctuation of energy is 1.93 and coefficient of fluctuation of speed is 0.03. If mean diameter of flywheel rim is 500 mm and hub and spokes provides 5% of rotational inertia of wheel. Find mass and cross section of flywheel, if density of flywheel material (C.I.) 7200 kg/m^3. [10]

(Q8) a) Give various steps to select vee belt from manufacturer's catalogue. [7]

b) Select flat belt to connect two transmission shafts rotating at 1000 and 500 RPM respectively. Centre to centre distance between shaft is approximately 2.5 m. The drive is open type. The power transmitted is 25 kW.

Belt is used to drive centrifugal pump with steady load

The belt operates at velocity range of 17.8 to 22.9 M/sec. The power transmitting capacity of belt per mm width per ply at 180° arc of contact and at belt velocity of 5.08 m/sec is 0.0147 kW.

Refer data sheet supplied. [10]

Load correction factor (F_c)

Type of load	F_c
i) Normal load	1.0
ii) Steady load, e.g. centrifugal pumps fans light machine tools - conveyors	1.2
iii) Intermittent load, e.g. heavy duty fans - blowers compressors - reciprocating pumps - line shafts heavy duty machines	1.3
iv) Shock load, e.g. vacuum pumps - rolling mills hammers - grinders	1.5

Arc of contact factor (F_a)

α_s (degrees)	120	130	140	150	160	170	180	190	200
F_a	1.33	1.26	1.19	1.13	1.08	1.04	1.00	0.97	0.94

Standard widths of these belts (in mm)

3V(9)	25	40	50	63	71					
4-(5)V	40	44	50	63	71	80	100	112	125	132
5-(8)V	71	100	112	125	132					
8-(5)V	112	125	132	180	200					

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Total No. of Pages : 3

Seat No.	

T.E. (Mechanical Engineering) (Semester - V) (Revised) Examination, May - 2015

MANUFACTURING ENGINEERING (New)

Sub. Code : 45565

Day and Date : Saturday, 23 - 05 - 2015 Total Marks : 100

Time : 1.30 p.m. to 5.30 p.m.

Instructions : 1) Question No. 1 and Question No. 5 are compulsory.
2) Solve two questions from remaining questions of each section.
3) Figures to the right indicate full marks.
4) Assume suitable data wherever necessary and state it clearly.
5) Use of non programmable calculator is allowed.

SECTION - I

Q1) The component shown in Fig. 1 is to be processed on a single spindle automat. Study the component and prepare [18]

a) Detailed process sheet

b) Tool Layout

c) Cam profile for drilling operation

d) Calculate production rate per hour

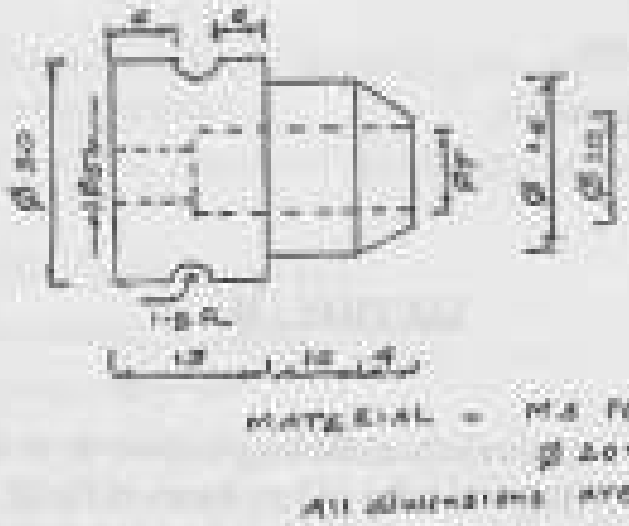

Fig.1

P.T.O.

Q2) a) Differentiate clearly between orthogonal and oblique cutting operation with neat sketch. [4]

b) Discuss in brief the methods of reducing BUE formation during metal cutting. [4]

c) The following values relate to a cutting test under orthogonal cutting conditions for machining of aluminum. Forces determined are $F_H = 1500$ N, $F_V = 1000$N, $A = 10°$, $r = \chi_c = 0.3t$. Determine as per Merchant's THEORY THE CUTTING FORCES N_c, F_s,N and F. Also determine the co-eff. At chip tool interface. [8]

Q3) a) Discuss in brief the factors affecting surface finish. [4]

b) Discuss in brief the selection criteria for cutting fluids [4]

c) A mild steel billet 160 mm Dia. Was turned with a carbide tool at 30 m/min. The tool life observed was 2.1 Hr. At the cutting of 25m/min tool life observed was to be 5.2 Hr. Derive Taylor's equation for the system. [8]

Q4) Write short notes on (Any Four): [16]

a) Types of chips

b) Tool materials

c) Tool signature

d) Tool dynamometers

e) Tool wear

f) Form tools

SECTION – II

Q5) Design and draw neat dimensional drawing in three views with one sectional view of a jig for drilling two holes ϕ12 as shown in fig. II. Show clearly the details of location, clamping and guiding elements. Assume this as a final operation. [26]

OR

Design and draw neat dimensional drawing in three views with one sectional view of a milling fixture for milling the 20 ± 0.05 mm wide slot at the component shown in fig. II. Show the details of location, clamping and setting of cutter. Assume this as a final operation.

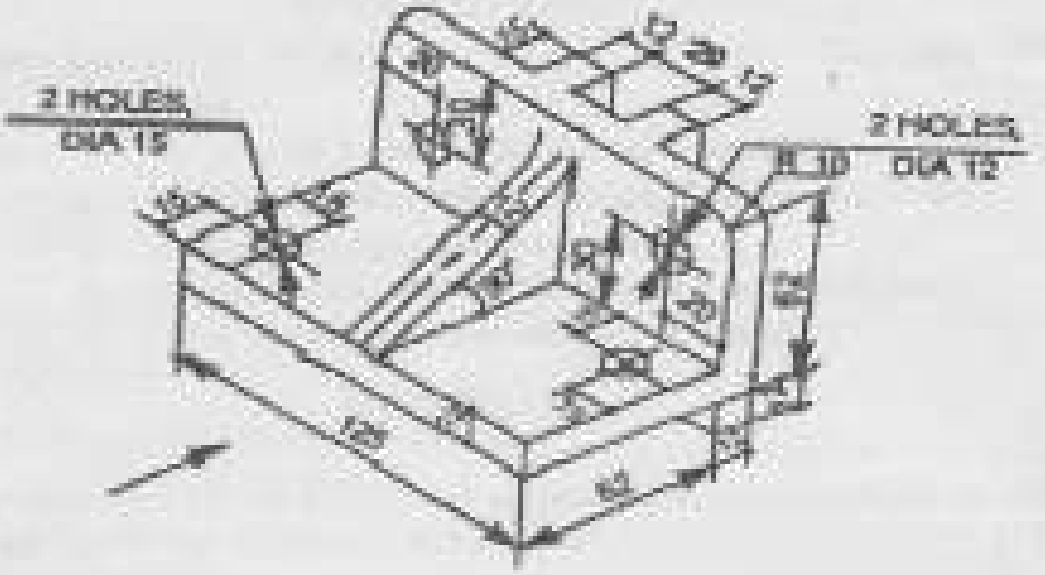

FIG-II

Q6) a) List the different methods of reducing cutting forces in press working. Explain what is shear on punch. [6]

b) Explain with neat sketch what is strip layout in press working. [6]

Q7) a) List the methods of distributing the depreciation and explain any one method in detail. [6]

b) Explain the concept of machine tool replacement. [6]

Q8) Write short notes on any two. [12]

a) Economics of tooling

b) Quick acting nut

c) Press working terminology

d) Center of pressure.

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Total No. of Pages : 3

Seat No.	

T.E. (Mechanical) (Part - I) (Semester - V) Examination, May - 2015

METROLOGY AND QUALITY CONTROL (New)

Sub. Code : 45564

Day and Date : Saturday, 30 - 05 - 2015 Total Marks : 100

Time : 02.30 p.m. to 05.30 p.m.

Instructions : 1) Answer any three questions from each section.

2) Figures to the right indicate full marks.

3) Draw neat labeled sketches wherever necessary.

4) Assume if necessary suitable data and state them clearly.

5) Use of non-programmable calculators is allowed.

SECTION - I

Q1) a) Distinguish between measuring instruments and comparators. [8]

b) Explain the procedure to transfer line standard to end standard. [8]

Q2) a) Explain Taylor's principle of gauge design. What do you mean by gauge makers tolerance and wear allowance. [8]

b) Calculate tolerances and limits for hole-shaft pair designated as Φ45H7g6 and also determine the minimum and maximum clearance. The dimension Φ45 lies between the range 30-50mm. Fundamental deviation of g shaft is $-2.5D^{0.34}$. The standard tolerance is given by $i = 0.45D^{1/3} + 0.001D$(microns) [8]

Q3) a) Explain the principle of interference of light and state the necessary conditions for interference of light. [8]

b) Explain the use of sine bar for measuring an angle with the help of neat sketch and state its limitations. [8]

P.T.O.

(Q4) Write short notes on (any three): [18]

a) Slip gauges

b) Sigma comparator

c) Auto collimator

d) Measurement of convex surface radius

e) Flatness testing of surface plate

SECTION - II

(Q5) a) State the various elements of a screw thread. Explain 3 - wire method to measure the effective diameter of screw thread. [8]

b) Explain the use of gear tooth vernier caliper for the measurement of gear tooth thickness. [8]

(Q6) a) Define quality control and state the objectives of quality control. [6]

b) Following data was obtained for diameter of a component from shop floor. Construct $\bar{X}$ and R charts and state whether the process is in control or not. [10]

Sample No	$\bar{X}$	R
1	50.04	0.07
2	50.24	0.08
3	50.14	0.03
4	50.08	0.05
5	50.28	0.04
6	50.16	0.09
7	50.30	0.04
8	50.10	0.04
9	50.16	0.05
10	50.10	0.07

For a sample of size "5" take A2=0.577, D4=2.114, D3=0

(Q7) a) Differentiate between 100% inspection and sampling inspection. [8]

b) What is cost of quality and explain cost of failure, cost of appraisal and cost of prevention. [8]

(Q8) Write short notes on (any three) : [18]

a) Tomlinson surface meter

b) Pitch measuring machine

c) Parkinson gear tester

d) Chance causes and assignable causes

e) Operating characteristics curves

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Total No. of Pages : 4

Seat No.

T.E. (Mechanical) (Semester - V) (Old) (Pre-revised) Examination, April - 2016

THEORY OF MACHINES - II

Sub. Code : 45549

Day and Date : Friday, 29-04-2016
Time : 10.30 a.m. to 1.30 p.m.

Total Marks : 100

Instructions : 1) Attempt any three questions from each section.
2) Figures to the right indicate full marks.
3) Assume suitable data, if necessary and state clearly.

SECTION - I

Q1) a) Derive the expression for efficiency in case of spiral gears. [6]

b) A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio. [10]

Q2) a) Write a note on various types of gear trains. [6]

b) An epicyclic gear train is shown in fig 2.b. [10]

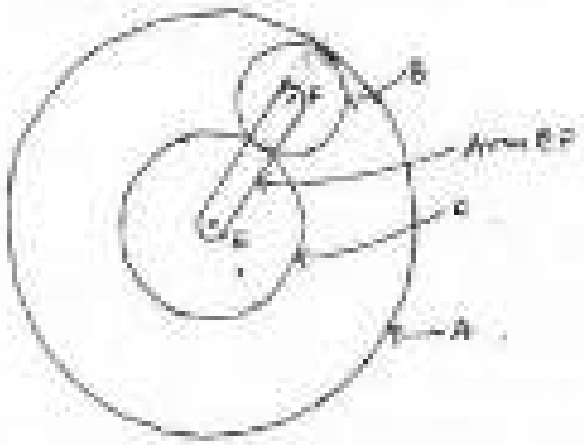

fig. 2.b.

P.T.O.

The annular gear A has 72 teeth and meshes with gear B. Gear C has 3 teeth and is engaged to Gear B. Arm EF which carries gears B and C rotates at a speed of 18 r.p.m. If gear A is fixed, determine the speed of gears B and C.

Q3) a) Write a note on stability of a two-wheeler while taking a turn. [6

b) The turbine rotor of a ship has a mass of 8 tonnes and a radius of gyration of 0.6m. It rotates at 800 r.p.m. clockwise when looking from stern end. Determine the gyroscopic couple and its effect if the ship travels at 40 km/hr and steers to the left in a curve of 75 m radius. [10

Q4) a) Explain balancing of several masses rotating in the same plane. [6

b) A, B, C and D are four masses carried by a rotating shaft at radii 18 mm, 240 mm, 120 mm and 150 mm respectively and the masses of B, C and D are 30 kg, 50 kg and 40 kg respectively. The planes containing masses B and C are 300 mm apart. The angle between the planes containing B and C is 90°. B and C make angles of 210° and 120° respectively with D in the same sense. [12

Find: i) The magnitude and angular position of A and

ii) The position of planes A and D.

SECTION - II

Q5) a) With the help of neat sketch represent vector method to represent vibratory motion and derive the relations between displacement vector, velocity vector and acceleration vector. [8]

b) A pendulum consists of a stiff weightless rod of length l carrying a m
m on its end as shown in Fig. 5b. Two springs each of stiffness k,
attached to the rod at a distance a from the upper end. Determine
natural frequency for the small oscillations. |

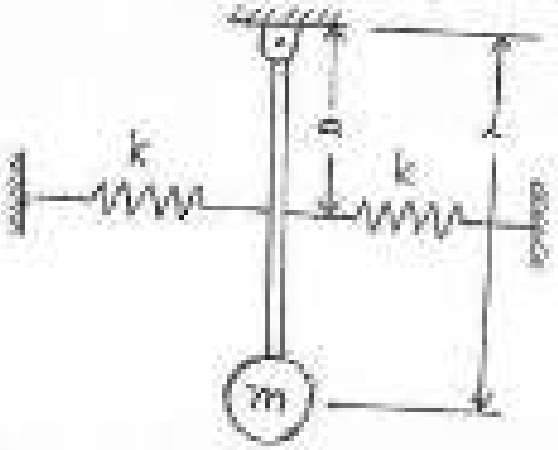

Fig.5b

Q6) a) What is meant by coulomb damping? Explain the rate of decay o
oscillations in this case.
[8]

b) A body of 5 kg is supported on a spring of stiffness 200 N/m and has
dashpot connected to it which produces a resistance of 0.002 N at a
velocity of 1 cm/sec. In what ratio will the amplitude of vibration be
reduced after 5 cycles.
[8]

Q7) a) Derive an expression for amplitude ratio of a single degree freedom system
subjected to harmonic excitation Force.
[8]

b) A 1000 kg machine is mounted on four identical springs of total spring
constant N and having negligible damping. The machine is subjected to a
harmonic external force of amplitude F_0 = 490 N and frequency 180
rpm. Determine the amplitude of motion of the machine and maximum
force transmitted to foundation because of the unbalanced force when
k = 2.96 × 10⁶ N/m.
[10]

Q8) a) Describe the phenomenon of 'whirling of shaft' and derive the formula for amplitude of vibrations of shaft rotating with angular speed 'ω' having a single disc of mass 'm' mounted at centre. The C.G. of disc has eccentricity 'e' with geometric centre of disc. Assume that there is no damping. [8]

b) A machine is supported by four isolators, each having stiffness of 350(0) N/m and damping coefficient of 50 N-s/m. A machine is to be isolated from a support having an amplitude of 0.05 mm at 60 rad/sec. If the total mass of machine is 50 kg. Determine, the amplitude of vibration of machine. [8]

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Total No. of Pages :3

Seat No.	

T.E(Mechanical)(Part-III)(Semester -V)(Old)(Revised) Examination, April - 2016
HEAT AND MASS TRANSFER
Sub. Code: 45550

Day and Date :Saturday, 30 - 04 - 2016 Total Marks :100

Time :10.30 a.m. to 1.30 p.m.

Instructions: 1) Solve any three questions from each section.
2) Write suitable assumptions wherever necessary and state it clearly
3) Figures to the right indicate fullmarks.
4) Use of scientific calculator is permitted.

SECTION-I

Q1) a) What do you mean by thermal conductivity what is the effect of temperature on thermal conductivity for various engineering material.[8]

b) A thick walled tube of stainless steel is 20 mm inside diameter and 40 mm outside diameter is covered with a 30mm layer of asbestos insulation Ck=0.2 w/mk if the inside wall temperature of the cylinder is maintained at 600°C and the outside insulation at 1000°C, calculate the heat loss per meter length of the pipe neglecting the resistance of stainless steel pipe.[8]

Q2) a) Derive the expression for temperature distribution and heat transfer for a plane wall with uniform heat generation [8]

b) The temperature on the two surfaces of a 25 mm thick steel plate(k=40W/mk)having a uniform volumetric heat generation of $30\times10^6 W/m^3$ are 180°C and 120°C. Neglecting the end effects determine:

i) The temperature distribution across the plane wall

ii) The location and the maximum temperature in the slab. [8]

Q3) a) Derive the expression for temperature distribution and heat transfer for a infinitely long fin. [8]

P.T.O.

b) A mercury thermometer placed in oil well is require to measure temperature of a compressed air flowing in a pipe. The well is 140 mm long and is made of steel (k=50 W/m°C) of 1mm thickness. The temperature recorded by the well is 100°C, while pipe wall temperature is 30°C. Heat transfer coefficient between the Air and the well is 30W/m²C. Estimate true temperature of air. [8]

Q4) Write short notes(any three) [18]

a) Radiation shield.

b) Plank's distribution law

c) Radiation shape factor

d) Spectrum of electromagnetic radiation

e) Radiation heat transfer between concentric cylinders.

SECTION-II

Q5) a) What are the various dimensionless numbers used in convection heat transfer? Give the significance of each number. [8]

b) A Nuclear reactor with its core constructed of parallel vertical plates 2.2m high and 1.4 m wide has been designed on free convection heating of liquid bismuth. The maximum temperature of plate surface is limited to 960 °C while, the lowest allowable temperature of bismuth is 340 °C. calculate the maximum possible heat dissipation from both the sides of plate. Use the following co-relation

$Nu=0.13(Gr.Pr)^{0.33}$ The thermodynamic properties of bismuth are:

μ=0.00088? Ns/m-s, Cp=150.7J/kg °C, K=13.02W/m °C,

$\beta=1.08\times10^{-3}k^{-1}$ [8]

Q6) a) Analyse the problem of forced convection by using dimensional analysis technique. [8]

b) A tube 5 m long is maintained at 100ranic properties of bismuth are:

μ = 0.000867N/m-s, Cp=150.7 J/kg °C by steam jacketing. A fluid flows through the tube at the rate of 2040kg/hr. at 30°C, the diameter of the tube is 2cm find the average heat transfer coefficient. Following are the properties of fluid:

ρ=850kg/m³,Cp=2000J/kg°C, K=0.12W/m°C, $\mu=19.8\times10^{-5}$ N-s/m²

Use $Nu = 0.023\ Re^{0.8}\ Pr^{0.33}$. [8]

Q7) a) Derive the expression for LMTD for parallel flow heat exchanger, state the assumptions made. [8]

b) The flow rates of hot and cold water streams running through a parallel flow heat exchanger are 0.2kg/s and 0.5 kg/s respectively. The inlet temperatures on the hot and cold sides are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. If the individual heat transfer coefficients on both sides are 650 W/m²°C, calculate the area of the heat exchanger. [8]

Q8) Write short notes on the following (any three) [18]

a) Fick's law of diffusion.

b) Overall heat transfer co-efficient for heat exchanger.

c) Heat pipe.

d) Boiling and condensation.

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Total No. of Pages : 3

Seat No.	

T.E. (Mechanical) (Part-I) (Semester-V)

Examination, May - 2016

MACHINE DESIGN-I

Sub. Code: 45551

Day and Date : Monday, 02- 05 - 2016 Total Marks : 100

Time : 10.30 a.m. to 1.30 p.m.

Instructions : 1) Answer any three questions from each section.

2) Figure to the right indicates full marks.

3) Make suitable assumptions wherever required and state the same clearly.

SECTION-I

Q1) a) Explain the various factor influencing the selection of material for a particular application. [6]

b) Suggest with justification the suitable material for the following components- [6]

i) Lathe bed.

ii) Crank shaft.

iii) Surgical instruments.

c) State the different theories of failure & explain one of them. [6]

Q2) a) Which are the different types of keys used for shafting. Explain the design procedure for sunk key. [6]

P.T.O.

b) Design a turn buckle for an axial load of 50 kN. All parts are made of steel having following properties: [10]

Allowable tensile stress (f_t) = 140 N/mm^2.

Allowable shear stress (f_s) = 75 N/mm^2.

Allowable crushing stress (f_c) = 160 N/mm^2.

Draw critical areas where failure is likely to take place & draw a sketch of turn buckle showing important dimensions.

Q3) a) Explain the design procedure of eccentrically loaded welded joint subjected to primary shear stress due to direct load and secondary shear stress due to turning moment as shown in Fig. 3a-I. [8]

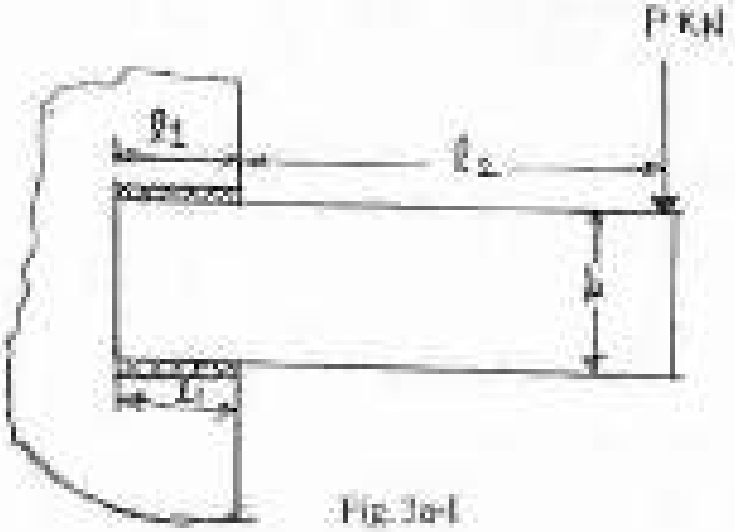

Fig. 3a-I

b) A bracket is bolted to a vertical pillar using six bolts; 2 bolts in each row as shown in Fig. 3b-I. The bracket carries a load of 24 kN. Assuming tensile stress for the bolt material as 80 MPa determine the bolt size. [10]

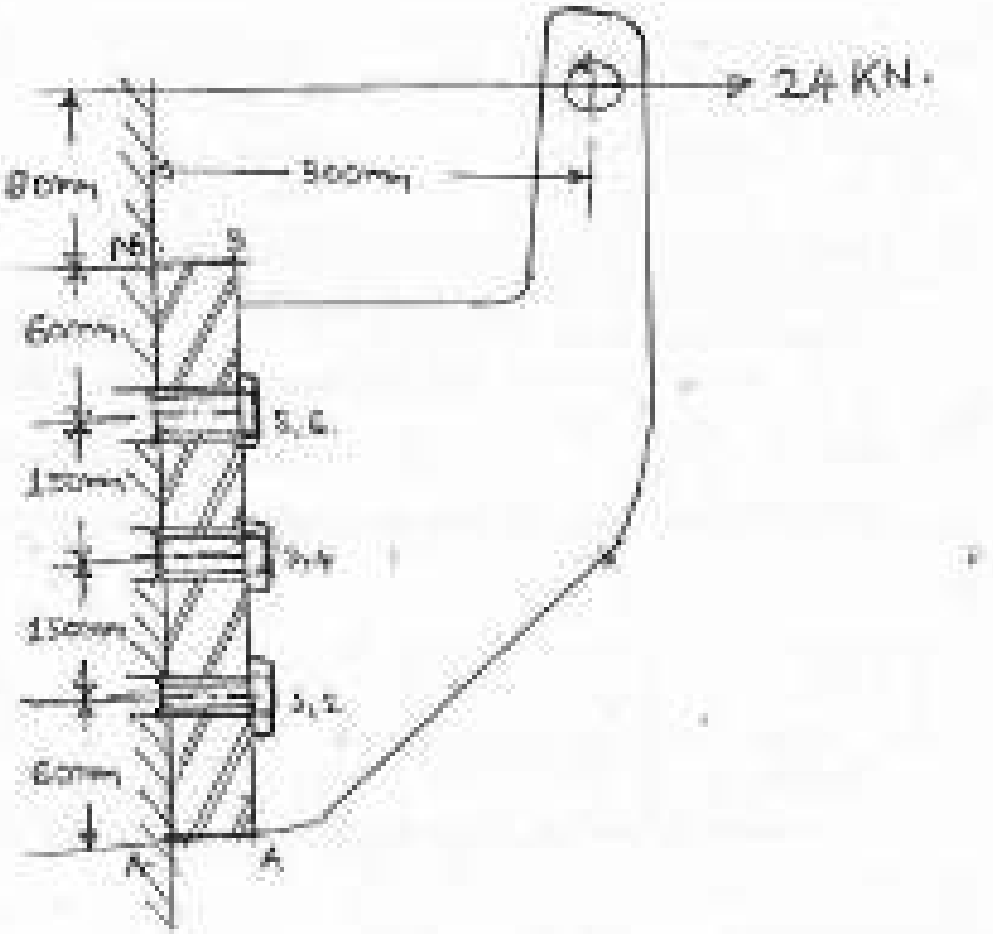

Fig. 3b-1

Q4) a) Discuss the advantages of welded joints over the bolted and riveted joints. [4]

b) Design the rigid flange coupling to transmit 40 KW at 180 rpm. Overload factor for the application is 1.5. Allowable shear stress for the shaft material is (f_s) = 79 MPa; for key and bolt material permissible shear stress is 80 MPa and crushing stress is 240 MPa. Allowable shear stress for flange material is 16.67 MPa. No. of bolts used are 4. Draw a dimensional sketch of the coupling. [12]

SECTION-II

Q5) a) Explain the stresses induced while designing a helical compression spring along with neat diagrams. [6]

b) Design a helical compression spring for a maximum load of 1050 N for a deflection of 25 mm, using the value of spring index as 5. The maximum permissible shear stress for spring wire is 420 N/mm² and modulus of rigidity is 84 kN/mm². Also draw neat sketch of the spring. Take Wahl's factor $K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$. The std. wire gauge (SWG) number and corresponding diameter of spring wire is given in following table. [10]

SWG	1	2	3	4	5
Diameter (mm)	7.620	7.010	6.401	5.893	5.385

Q6) a) What do you understand by overhauling and self locking of power screw? How does it affect the efficiency of screw? [6]

b) A triple start square threaded screw is used to raise a load of 50 kN. The screw has a nominal diameter of 50 mm and pitch of 8 mm, height of nut is 40 mm and coefficient of friction between nut and screw is 0.12. There is no collar friction. Find the maximum shear stress induced in the screw and nut threads. Also find the bearing pressure between screw and nut. [10]

Q7) a) Derive an expression for energy stored in flywheel. [8]

b) A rimmed flywheel made of grey cast iron having mass density of 7100 kg/m³ is used on a punching press running at a mean speed of 200 r.p.m. The punching operation consists of one quarter revolution during which the flywheel is required to supply 3000 N-m of energy. The coefficient of speed fluctuations is limited to 0.2. The rim which contributes 90% of the required moment of inertia, has a mean radius of 0.5m due to space limitations. The cross-section of the rim is square. Determine its dimensions. [8]

Q8) a) Give in steps the procedure for selection of V-belt from manufacturers catalogue. [8]

b) It is required to select a flat belt drive to connect two transmission shafts rotating at 800 and 400 r.p.m. respectively. The centre-to-centre distance between the shafts is approximately 3m and the belt drive is open type. The power transmitted by the belt is 30 KW and the load correction factor is 1.3. The belt should operate at a velocity between 17.8 to 22.90 m/s. The power transmitting capacity of the belt per mm width per ply at 180° arc of contact and at a belt velocity of 5.08 m/s is 0.0147 KW. Select preferred pulley diameters and specify the belt.

Refer the data given for Q. 8 (b) [10]

Load correction factor (F_c)

Type of load	F_c
i) Normal load	1.0
ii) Steady load, e.g. centrifugal pumps-fans-light machine tools - conveyors	1.2
iii) Intermittent load, e.g. heavy duty fans - blowers compressors - reciprocating pumps - line shafts heavy duty machines	1.3
iv) Shock load, e.g. vacuum pumps - rolling mills hammers - grinders	1.5

Arc of contact factor (F_α)

α_1 (degrees)	120	130	140	150	160	170	180	190	200
F_α	1.33	1.26	1.19	1.13	1.08	1.04	1.00	0.97	0.94

Standard widths of these belts (in mm)

3-Ply	25	40	50	63	76					
4-Ply	40	44	50	63	76	90	100	112	125	152
5-Ply	76	100	112	125	152					
6-Ply	112	125	152	180	200					

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Total No. of Pages : 4

Seat No.

T.E. (Mechanical) (Part - I) (Semester - V) (Old)
Examination, May - 2016
MANUFACTURING ENGINEERING
Sub. Code : 45565

Day and Date : Saturday, 07-05-2016 Total Marks : 100

Time : 09.30 a.m. to 01.30 p.m.

Instructions :
1) Q.1 and Q.5 are compulsory.
2) Solve two questions from remaining questions of each section.
3) Figures to the right indicate full marks.
4) Assume if necessary suitable data and state them clearly.
5) Use of non-programmable calculators is permissible.

SECTION - I

Q1) The component shown in Fig. 1 is to be processed on a single spindle automat. Study the component and prepare: [18]

a) Detailed process sheet.

b) Tool Layout.

c) Cam profile for drilling operation.

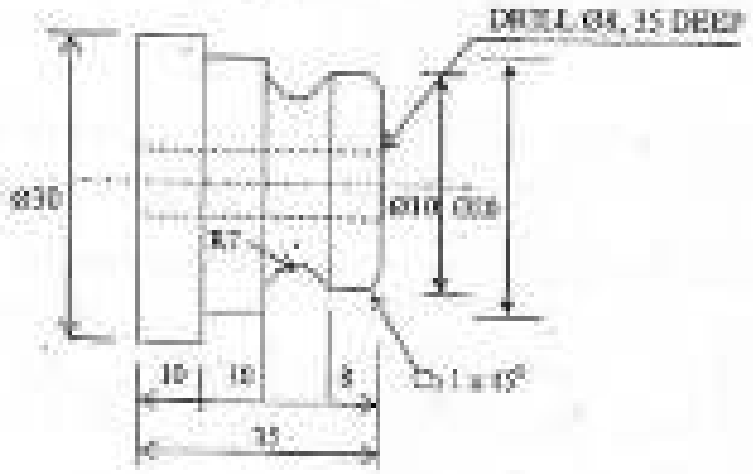

Figure 1. Material: M. S. Ø30 Bar

P.T.O.

Q2) a) Derive an expression for $\phi = \frac{r\cos\alpha}{1 - r\sin\alpha}$ [8]

Where ϕ - shear angle

α = rake angle

and r = chip thickness ratio

State assumptions made.

b) In orthogonal cutting test with a tool signature as 12-10-6-8-12-0-0.63 the following observations were made: [8]

Chip thickness ratio: 0.35,

Horizontal component of cutting force = 1900 N

Vertical component of cutting force = 850 N

Determine:

i) The various components of forces,

ii) Coefficient of friction at chip tool surface

iii) Shear strain.

Q3) a) Explain the tool signature of single point cutting tool. [6]

b) Explain the details in tool wear phenomenon. [10]

Q4) a) Explain the concept of heat generation in metal cutting and use of coolants. [8]

b) Explain the mechanics of chip formation with neat sketch. [8]

SECTION - II

Q5) Design and draw a neat dimensional sketch in three views with one section view. For drilling two Holes ø12 through as shown in Figure - II and showing clearly details of clamping and location of workpiece. Assume this as final operation. [26]

OR

Design and draw a neat dimensional sketch in three views with one sectional view of a milling fixture. For milling surface (*) both sides as shown in figure - II showing clearly details of location, clamping of workpiece and cutter setting. Assume this as a final operation.

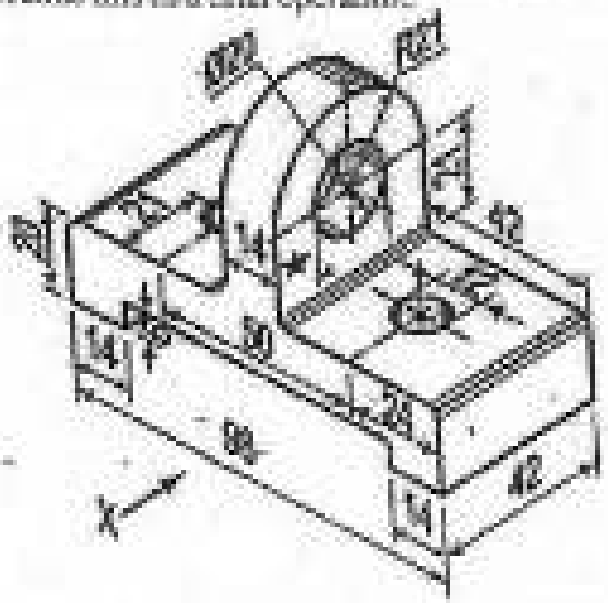

Fig - II.

Q6) a) Discuss methods of reducing cutting forces in press working. [6]

b) Explain the following terms in press working. [6]

i) Spring back Effect

ii) Clearance

iii) Strip layout

Q7] a) Differentiate between

i) Direct cost and indirect costs.

ii) Fixed cost and variable costs. [6]

b) List the basic methods for replacement and selection of tools and explain any one method. [6]

Q8] Write short notes on (Any two) : [12]

a) Design principles common to jigs and fixtures

b) Centre of pressure and knockouts.

c) 3-2-1 principle

d) Indexing elements.

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Total No. of Pages : 7

Seat No.	

T.E. Mechanical (Semester - V) (Pre - revised)
Examination, May - 2016
CONTROL ENGINEERING
Sub. Code : 48709

Day and Date : Monday, 09-05-2016 Total Marks : 100

Time : 10.30 a.m. to 1.30 p.m.

Instructions: 1) Attempt any three questions from Section I and Section II.
2) Assume any additional data if required and mention it clearly.
3) Figures to right indicate full marks.

SECTION - I

Q1) a) Show that the system shown in figure 1a and 1b are analogous. In figure 1a x_1 and x_2 represents input and output displacement respectively. [8]

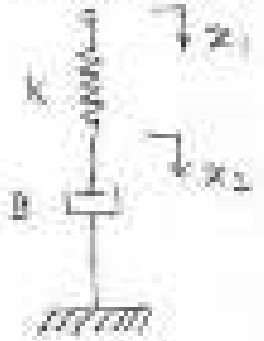

Figure 1-a

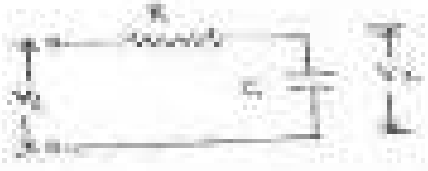

Figure 1 - b

P.T.O.

b) Draw general electrical representation for the mechanical system shown in figure 3, then draw an equivalent electrical circuit using force current analogy. [6]

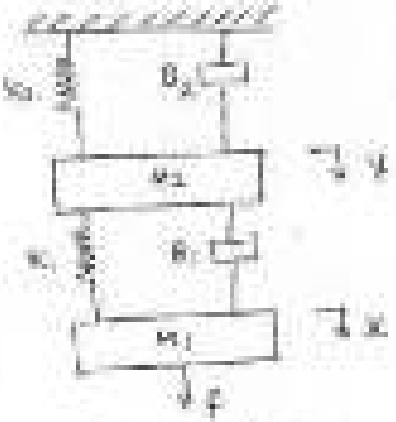

Fig 3.b

c) Obtain mathematical model for the thermal system shown in figure 3.c, where T_o is outlet temperature of air, T_i is inlet temperature of air and H is heat input. [6]

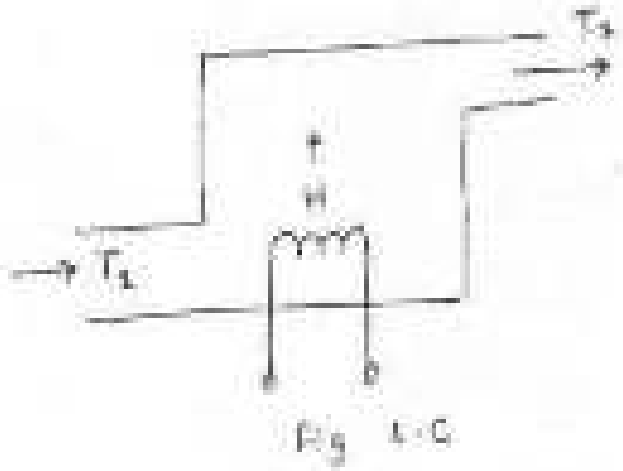

Fig 3.c

Q2) a) Determine linear approximation for the equation of volume of sphere given by $V = \pi R^2 H$, where r is radius of the base and H is altitude. [8]

b) The characteristics curves of an engine are given by the family of curves shown in figure 2b. Determine the linear approximation for the engine. [8]

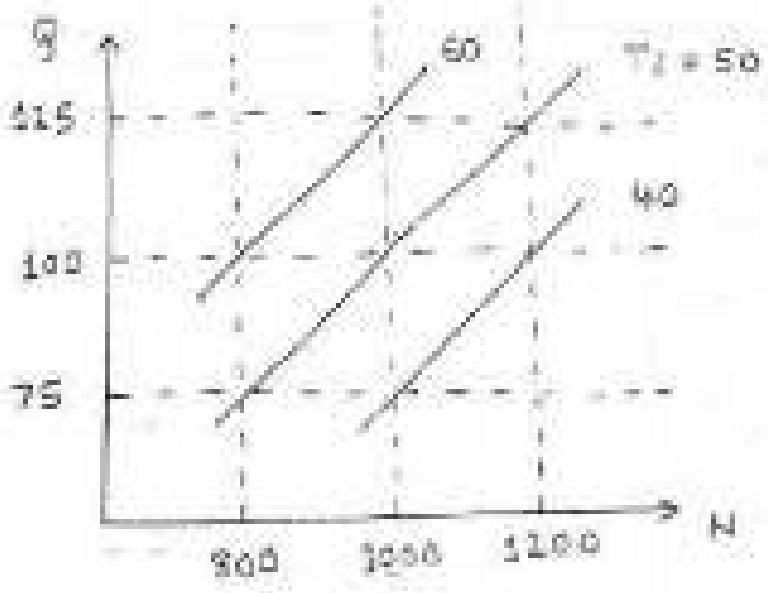

Figure 2 - b

Q3) a) The block diagram for a jet pipe amplifier is shown in figure 3a. Determine k and a such that the amplifier will have a steady state gain of 1 and a time constant of 0.25 sec. [8]

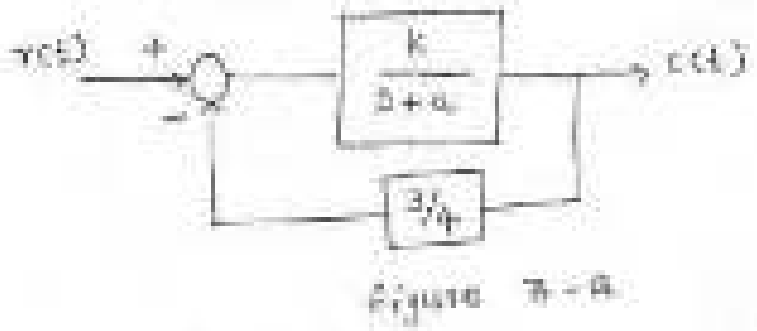

Figure 3 - a

b) The steady state operating curves for a system to be controlled are shown in figure 3b. The reference operating conditions are $V_r = C_r = 100$, $U_r = 40$ and $M_r = 60$. Determine the values of K_c and K_m. Determine the required slope of controller lines such that when the load changes from 40 to 50, the output will not change by more than 2 units. For K_m 1.6 determine the value of Δ such that $\zeta = 1$, when $\omega_n = 0$. [8]

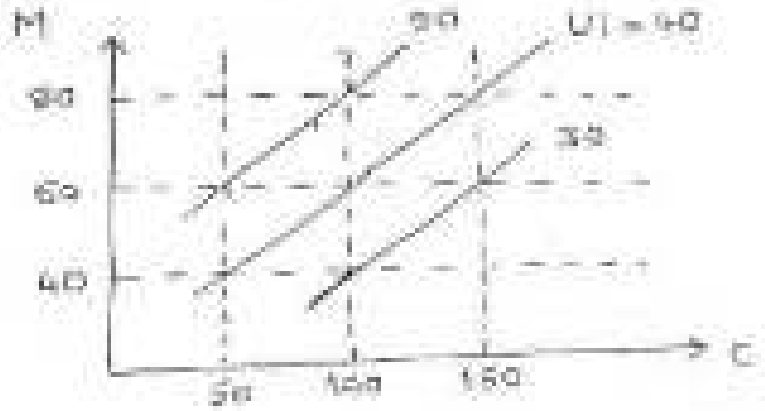

Figure 3-b

Q4) a) For the proportional control system shown in figure 4a, determine k_1, k_2 and κ such that system will have a steady state gain of 1, a natural frequency of 2 rad/s and a damping ratio of 0.5. [8]

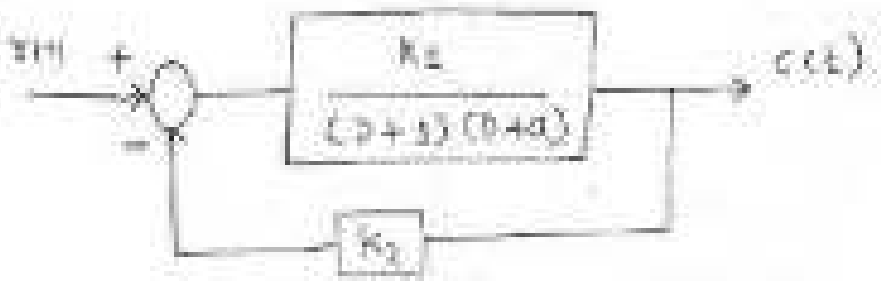

figure 4-a

9) Find transfer function for the system shown in figure 4b using block diagram reduction rules. [8]

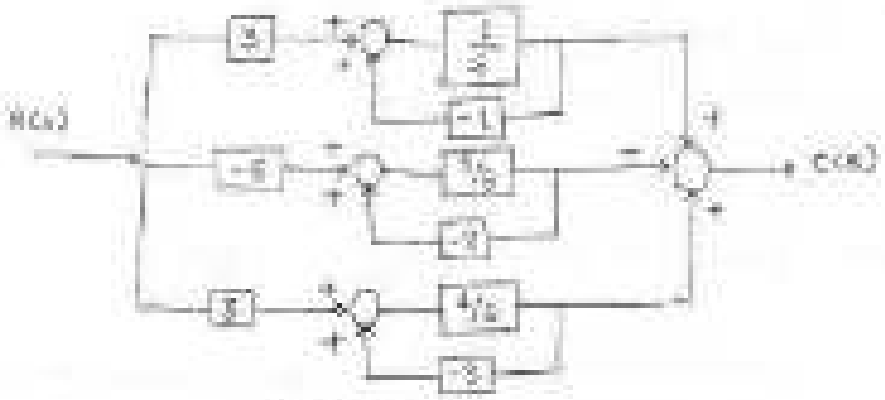

Figure 4-b

SECTION - II

Q5) a) Determine the value of k and a for the system shown in figure 5a such that the characteristics equation has a real root at -1 and at -5. Also determine response c(t) when r(t) = 0 and c(0) = 4, C'(0) = 0. [8]

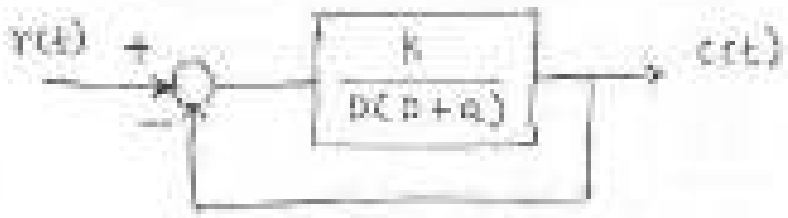

Figure 5 - a

b) The open loop transfer function of unity feedback system is given by $\frac{K}{S(1+0.4S)(1+0.25S)}$. Find range of value of K so that the closed system is absolutely stable. [8]

Q6] a) Sketch the root locus for the function $G(S)H(S) = \frac{K}{S(S^2+4S+13)}$. [10]

b) Determine damping ratio, peak time and peak overshoot for the system shown in figure 6b [8]

Figure 6 – b

Q7] a) Servo control system is described by the differential equation $y(t) = \frac{2(D+5)}{(D+2)(D+3)(D+4)} f(t)$. Determine the computer diagram and state space representation by direct and parallel programming method. [8]

b) Determine state space representation for the system shown in figure 7b. [8]

Figure 7 – b

Q8) a) Find response of first order control system to unit impulse and unit step function. When all initial conditions are zero. [8]

b) Use general programming to find computer diagram and state space model for the system having transfer function $\frac{C(s)}{R(s)} = \frac{(s+3)}{s(s^2+2s+28)}$ [8]

OR

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Total No. of Pages :3

Seat No.

T.E.(Mechanical Engineering)(Part-I)(Semester -V)(Revised) Examination, April - 2016

THEORY OF MACHINES-II

Sub. Code:66242

Day and Date : Saturday, 30 - 04 - 2016 Total Marks :100

Time :10.30 a.m. to 1.30 p.m.

Instructions :
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat labelled sketches wherever necessary.
4) Assume if necessary suitable data and state clearly.
5) Use of Non programmable calculator is permitted.

Q1) a] Prove that the condition for maximum efficiency in case of spiral gear is $\alpha = \frac{\theta + \phi}{2}$ where ϕ = friction angle, θ = shaft angle and α= spiral angle on the driving wheel. [8]

OR

Derive an expression for minimum number of teeth required on wheel to avoid interference in mesh with gear.

b) Two mating involute gears of 20° pressure angle, number of teeth on pinion 20, gear ratio 2, speed of pinion 250 rpm, module 12 mm. If the addendum of each wheel is such that the path of approach and path of recess on each side are half the maximum possible length each, find

i) addendum for both the wheels,

ii) length of arc of contact. [10]

Q2) a) Explain the working of Differential gear of an automobile. [6]

OR

P.T.O.

Motor shaft A exerts a constant torque and is geared to shaft B. The speed of shaft B is G times the speed of motor. Show that the angular acceleration of the shaft B is maximum when $G = \sqrt{(I_a / I_b)}$ where, I_a and I_b are the total mass moments of inertia of revolving parts attached to the respective shafts.

b) An epicyclic train of gears is arranged as shown in fig. 2b. How many revolutions does the arm, to which the pinions B and C are attached, make: [10]

i) When A makes one revolution clockwise and D makes half a revolution anticlockwise,

ii) When A makes one revolution clockwise and D is stationary? The number of teeth on the gears A and D are 40 and 90 respectively.

Fig.No.2b

Q5) a) Explain the effect of gyroscopic couple on ship during steering,pitching and rolling. [6]

b) Each road wheel of a motor cycle has a mass moment of inertia 1.5 kg-m^2. The rotating parts of the engine of the motor cycle have a mass moment of inertia of 0.25kg-m^2. The speed of the engine is 5 times the speed of the wheels and is in the same sense.The mass of the motor cycle with its rider is 250kg and its center of gravity is 0.6m above the ground level. Find the angle of wheel if the motor cycle is travelling at 50km per hour and is taking a turn of 30 m radius. Wheel diameter is 0.6 m. [10]

Q4) a) Explain different types of dynamic forces acting in single slider crank chain mechanism. [6]

OR

What conditions are to satisfied for a system to be dynamically equivalent to a given system.

b) Connecting rod of a gas engine has mass of 70kg and has a radius of gyration of 36 cm, about axis through the centre of gravity. The length of the rod between centres is 100 cm and the centre of gravity is 33 cm from the crank pin centre. If the crank length is 22.5 cm and revolves at a uniform speed of 250 rpm. Determine the magnitude and the direction of the inertia force on the rod and the corresponding torque on the crank shaft when inclination to inner dead centre is 30°. [10]

Q5) a) Explain why reciprocating masses are partially balanced. [6]

OR

Explain the balancing of several masses rotating in same plane.

b) A five cylinder in-line engine running at 750 rpm has successive cranks 144° apart, the distance between the cylinder lines being 375 mm. The piston stroke is 225mm and the ratio the connecting rod to the crank length is 4. Examine the engine for balance of primary and secondary forces and couples and find their maximum values. The reciprocating mass for each cylinder is 15kg. [12]

Q6) a) Explain maximum fluctuation of energy and coefficient of fluctuation of energy. [6]

b) The turning moment diagram for a petrol engine is drawn to the following scales: Turning moment 1mm=5 N-m, crank angle 1mm = 1°. The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below the mean turning moment line taken in order are 295, 685, 60, 340, 960, 270 mm². The rotating parts are equivalent to a mass of 36kg at a radius of gyration of 150 mm. Determine the coefficient of fluctuation of speed when the engine runs at 1800 rpm. [10]

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Total No. of Pages : 4

Seat No.	

T.E. (Mechanical) (Part-III) (Semester-V)

Examination, May - 2016

HEAT AND MASS TRANSFER

Sub. Code: 66243

Day and Date : Monday, 02-05 - 2016 Total Marks : 100

Time : 10.30 a.m. to 1.30 p.m.

Instructions : 1) All questions are compulsory.
2) Figure to the right indicates full marks.
3) Assume suitable data whenever necessary and state it clearly.
4) Use of specific calculators is permitted.

Q1) Solve Any Three:

a) Define critical radius of insulation. Also derive the equation for critical radius of insulation for hollow sphere. [6]

b) What are the modes of mass transfer? Explain Ficks law of diffusion. [6]

c) Air at 90°C flows in a copper tube (k = 384 W/mK) of 4 cm inner diameter and with 0.6 cm thick walls which are heated from the outside by water at 125°C. A scale of 0.5 cm thick is deposited on outer surface of the tube whose thermal conductivity is 1.75 W/mK. The air and water side heat transfer coefficients are 221 and 3695 W/m²K, respectively. Find overall heat transfer coefficient on the outside area basis. [6]

d) A steam pipe is covered with two layers of insulation. The inner layer (k = 0.17 W/mK) is 30mm thick and the outer layer (k = 0.023 W/mK) is 50mm thick. The pipe is made of steel (k=58W/mK) and has inner diameter and outer diameter of 160 and 170 mm, respectively. The temperature of saturated steam is 300°C and the ambient air is at 30 °C. If the inside and outside heat transfer coefficients are 30 and 5.8 W/m²K, respectively, calculate the rate of heat loss per unit length of pipe. [6]

P.T.O.

Q2) Solve Any Two:

a) Explain Lumped heat capacity analysis. Also give the physical significance of Biot number. [8]

b) Steel ball bearings (k = 30 W/mK, $\alpha = 1.3 \times 10^{-5}$ m²/s) having a diameter of 40mm are heated to a temperature of 650°C and then quenched in a tank of oil at 25°C. If the heat transfer coefficient between ball bearings and oil is 500 W/m²K. Determine the duration of time the bearing must remain in a oil to reach a temperature of 200°C. [8]

c) A plate 2 cm thick and 2 cm wide is used to heat a fluid at 30°C. The heat generation rate inside the plate is 7×10^6 W/m³. Determine heat transfer coefficient to maintain the temperature of the plate below 180°C. Take k for plate 26 W/mK. Neglect heat losses from the edge of plate. [8]

Q3) Solve Any Two:

a) Explain the error estimation of temperature measurement in thermowell. [8]

b) A well filled thermometer well made of a steel tube (k = 35.8 W/mK), 120 mm long and 1.5 mm thick is installed in a tube through which air is flowing. The temperature of air stream is measured with the help of thermometer placed in the well. The surface heat transfer coefficient of the air stream measured with the help of a thermometer placed in the well. The surface heat transfer coefficient from the air to the well is 23.3 W/m²K and the temperature recorded by the thermometer is 88°C. Estimate the measurement in error and the percentage error if the temperature at the base of the wall is 40°C. [8]

c) An aluminium alloy fin (k = 200 W/mK), 3.2 mm thick and 2.5cm long protrudes from the wall. The base is at 420°C and ambient air temperature is 30°C. The heat transfer coefficient may be taken as 12 W/m²K. Find the heat loss and fin efficiency if the heat loss from the fin tip is negligible. [8]

Q4) Solve Any Three of the following:

a) Analyze the problem of natural convection by using dimensional analysis technique. [6]

b) Write a short note on thermal boundary layer. [5]

c) Consider a design of nuclear reactor using free convection of liquid bismuth. The reactor core is constructed of parallel vertical plates of 2m high and 1.5m wide. Find the maximum possible heat dissipation from both side of each plate if the surface temperature of the plate is 950°C and lowest allowable bismuth temperature is 350°C. Properties of bismuth are, $\rho = 10030$ kg/m^3, Cp = 0.15 kJ/kg K, k = 11.2 W/mK, $\mu = 8.7 \times 10^{-4}$ N sec/m^2, $\beta = 1.3 \times 10^{-4}$ 1/K. Use the correlation: $Nu = 0.13 (Gr. Pr)^{1/3}$ [6]

d) 30 kg/minute of water is heated from 30°C to 50°C by passing through a pipe of 2 cm diameter which is maintained at 100°C. find the length of the pipe required, the properties of water are $\rho = 985$ kg/m^3, Cp = 4208 J/kg K, k = 0.585 W/mK, $\nu = 0.33 \times 10^{-6}$ m^2/sec. Use the correlation $Nu = 0.023\ Re^{0.8}\ Pr^{0.33}$ [5]

Q5) Solve Any Three of the following:

a) State and explain Kirchhoff's law. [5]

b) Write a short note on Radiation shape factor. [6]

c) The temperature of a flame in the furnace is 2900 K. Find λ_{max}. [5]

d) The inner sphere of a liquid oxygen container is 35cm in diameter and outer sphere is 36cm in diameter, both spheres are having emissivity as 0.05. Determine the heat leakage rate in to the liquid oxygen container which is at –183°C. [6]

Q6) Solve Any Three of the following:

a) Derive the expression for LMTD for counter flow heat exchanger. [6]

b) Write a short note on design considerations of heat exchanger. [5]

c) What do you mean by condensation? What are the types of condensation? Which type of condensation is preferred? Justify your answer. [5]

d) Draw the temperature distribution for the following heat exchangers. [6]

i) Condenser.

ii) Evaporator.

iii) Counter flow heat exchanger having equal heat capacities.

iv) Counter flow heat exchanger having effectiveness equal to unity.

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Total No. of Pages : 4

Seat No.	

T.E. (Mechanical) (Semester - V) (Revised) Examination, May - 2016

MANUFACTURING ENGINEERING

Sub. Code : 66245

Day and Date : Saturday, 07-05-2016 **Total Marks : 100**

Time : 9.30 a.m. to 1.30 p.m.

Instructions :
1) All questions are compulsory.
2) Figures to right indicate full marks to the question.
3) Assume if necessary suitable data and state them clearly.
4) Use of non-programmable calculators is permissible.

Q1) Solve any two:

a) Explain the different types of chips formation with neat labeled diagrams. [8]

b) What is machinability. Explain various factors affecting machinability. [8]

c) Following observations were made during orthogonal cutting operation of a diameter 50 mm M.S bar. Depth of cut = 1.2 mm, cutting force = 1000 N, feed force = 300 N, spindle speed = 240 r.p.m., feed = 0.2 mm/rev., chip thickness after cut = 0.5 mm, rake angle = 12°. [8]

Find out i) Shear plane angle

ii) Cutting velocity, chip velocity and shear velocity.

iii) Coefficient of friction between chip and tool.

Q2) Solve any two

a) Define tool life. Discuss various factors affecting tool life. [8]

P.T.O.

b) Draw tool geometry of a milling cutter and explain nomenclature in detail. [8]

c) A carbide tool with mild steel workpiece was found to give a life of 2 hours while cutting at 60 m/min. Compute the tool life if the same tool is used at a speed 30% higher than the previous one. Also determine the cutting speed for required tool life of 180 minutes. Assume Taylor's Equation as $VT^{0.25}$ = Constant. [8]

Q3) The component shown in fig. 1 is to be processed on a single spindle automat. Study the component and prepare: [18]

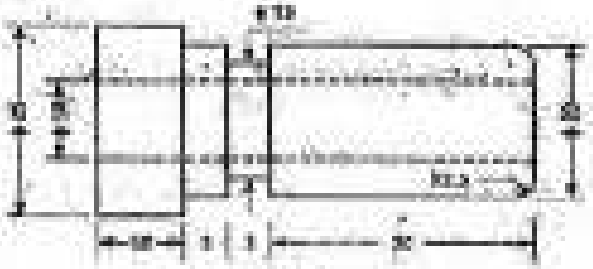

Fig. 1

Material - ϕ 25 polish brass bar

All dimensions are in mm. (Fig. not to scale)

a) Detailed process sheet

b) Tool layout

c) Cam profile for drilling operation.

Q4) Solve any one

a) Design and draw neat dimensional drawing in three views with one sectional view of a jig for drilling two holes of Φ12 through as shown in fig.4a. Show clearly the details of clamping and location of workpiece. Assume this as a final operation. **[26]**

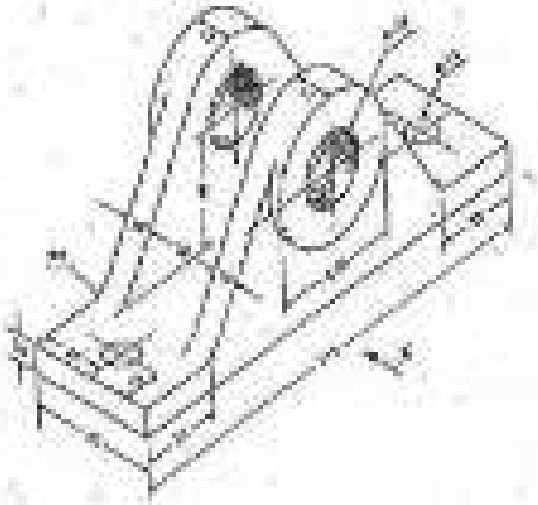

Fig.4a

b) Design and draw a neat dimensional sketch in three views with one sectional view of a milling fixture for milling 3± 0.05 mm wide slot at the component as shown in fig 4b. Show the details of location, clamping and cutter setting. Assume this as a final operation. **[26]**

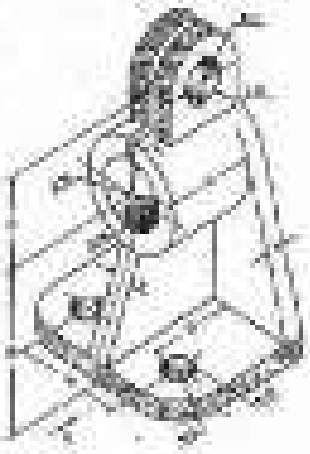

Fig.4b

Q5) Solve any two

a) With neat sketch write down different types of dies. [6]

b) Find the total pressure, dimensions of tools to produce a washer 5cm outside diameter with a 2.4 cm hole, from material 4 mm thick, having a shear strength of 360 N/mm^2. [8]

c) Discuss design considerations for die element. [4]

Q6) Write Short notes on any three: [12]

a) Work holding devices in CNC.

b) Automatic tool changers.

c) Automatic pallet change.

d) Tool materials and tool geometry signature of CNC.

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Total No. of Pages :3

Seat No.	

T.E.(Mechanical Engg.)(Part-I)(Semester -V)(Old) Examination, May - 2016
METROLOGY AND QUALITY CONTROL
Sub. Code: 45564

Day and Date :Tuesday, 03 - 05 - 2016 Total Marks :100

Time :10.30 a.m. to 1.30 p.m.

Instructions: 1) Answer any three questions from each section.
2) Figures to the right indicate full marks.
3) Draw neat figures wherever necessary.
4) Assume suitable data only wherever necessary and state them clearly.
5) Use of non-programmable calculator is permitted.

SECTION-I

Q1) a) Explain briefly classification, care and use of slip gauge with the help of figures. [8]

b) What is essential purpose fo c limit system? Explain in se different types of fits using figures. [8]

Q2) a) Explain with neat sketch construction and working of vernier caliper.[8]

b) Calculate the fundamental deviation and tolerances and hence the limits of size for the shaft and hole pair designated as 55 mm H_8-f$_7$.The tolerance limit is given as.

$i = 0.45\sqrt{D} + 0.001D$ Microns

The diameter steps are 50 mm and 80 mm. The tolerance grade for number 8 quality is 25i and for number 7 quality is 16i. [8]

Q3) a) Describe with neat sketch explain the measurement of concave and convex surface radius. [8]

b) Discuss the use of autocollimator,for checking flatness of the surface plate. [8]

P.T.O.

Q4) Write short notes on any three [18]

a) Line and end measurement.

b) Level beam comparator

c) Dial gauges

d) Hole base system and shaft base system

e) Clinometers.

SECTION-II

Q5) a) Describe the construction and working of any one instrument used in surface finish measurement. [8]

b) Describe different errors occurred in a screw thread. [8]

Q6) a) Explain Parkinson's gear tester with sketch. [8]

b) What do you know by cost of quality and value of quality? How to balance them? [8]

Q7) a) Explain operating characteristic curves with neat sketch. [8]

b) Table given below shows number of defectives found in inspection of a lot for 100 plugs each.plot a P chart and check a process is in control or not. [8]

Lot Number	1	2	3	4	5	6	7	8	9	10
Number of defectives	6	3	1	4	3	0	11	5	2	3

[18]

Q8) Write short notes on any three

a) Objectives of quality control.

b) $\bar{X}$ chart

c) Variable inspection and attribute inspection

d) Sampling inspection & percentage inspection

e) AWQL and LTPD

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Total No. of Pages : 4

Seat No.

T.E. (Mech.) (Semester - V) (Revised) Examination, April - 2016

CONTROL ENGINEERING

Sub. Code : 66241

Day and Date : Friday, 29 - 04 - 2016 Total Marks : 100

Time : 10.30 a.m. to 1.30 p.m.

Instructions: 1) All questions are compulsory.
2) Assume suitable data wherever required and mention it clearly.
3) Figures to right indicate full marks.

Q1) a) Construct grounded rheir representation for the mechanical system shown in fig. 1a and draw electrical network using direct analog. [6]

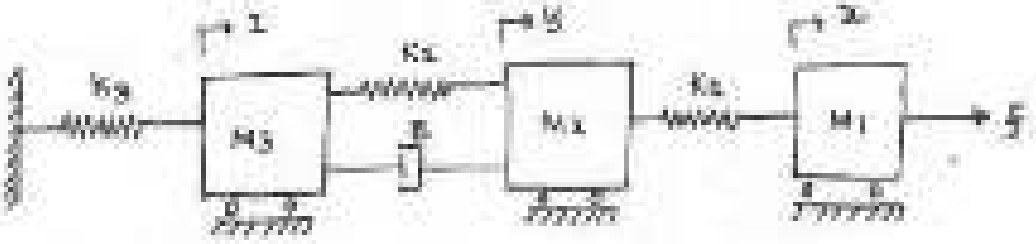

Fig . 1 a

b) For the thermal system, shown in fig 1 b, find equation of T as a function of E_i and T_i when $Q_i = E_i$ [6]

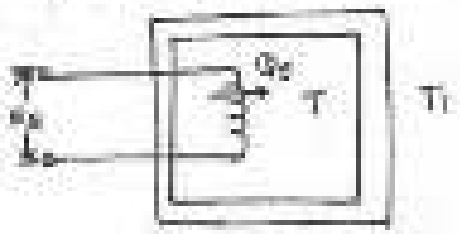

Fig . 1 b

P.T.O.

c) For the gear train shown in fig. 1c, derive equation between motor torque (T_M) and load torque (T_L). [6]

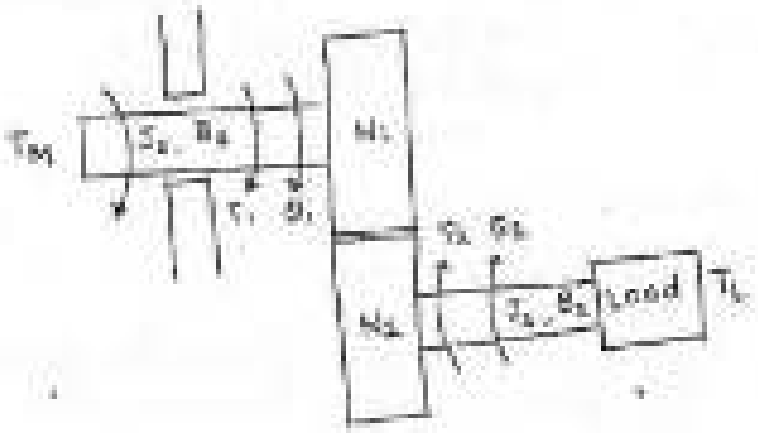

Fig: 1 c

Q2) a) For a sonic flow of air through a restriction, the mass flow rate $M = \frac{0.53}{\sqrt{T}} A.P$, where M is mass flow rate, T is inlet temperature, A area of restriction and P is the inlet pressure. Determine the linear approximation for M when area A is held constant. [5]

b) Reduce the block diagram shown in Fig. 2b and find $\frac{C(S)}{R(S)}$. [11]

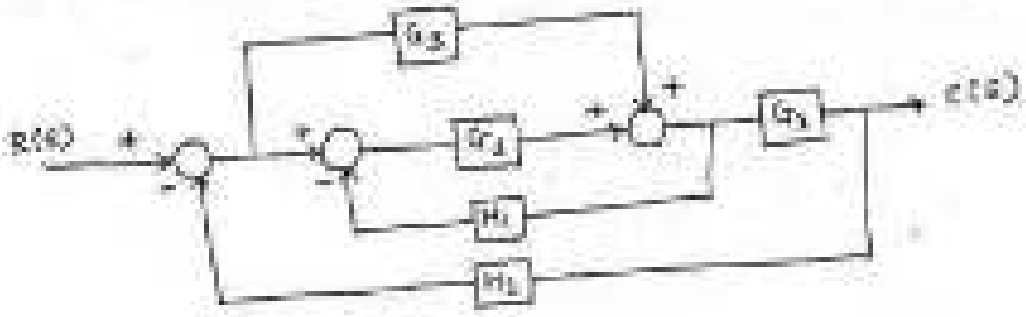

Fig: 2 b

Q3) a) Pole zero configuration of the overall transfer function is shown in Fig 3a. Determine its response for unit step input. [8]

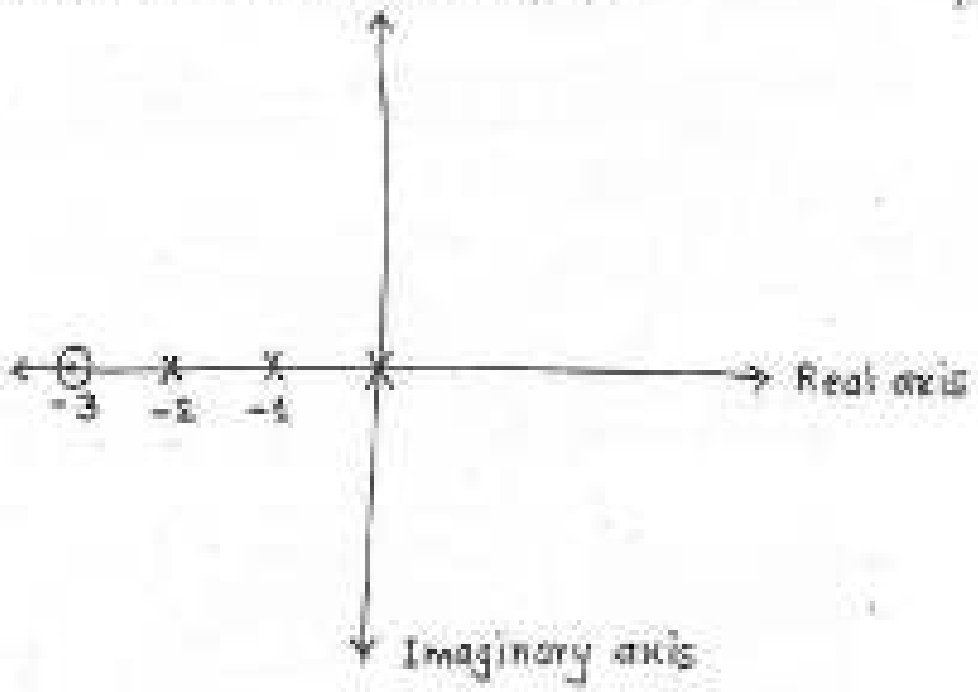

Fig. 3 a

b) The step response of a second order control system is shown in figure 3b. Determine the closed loop transfer function of the system. [8]

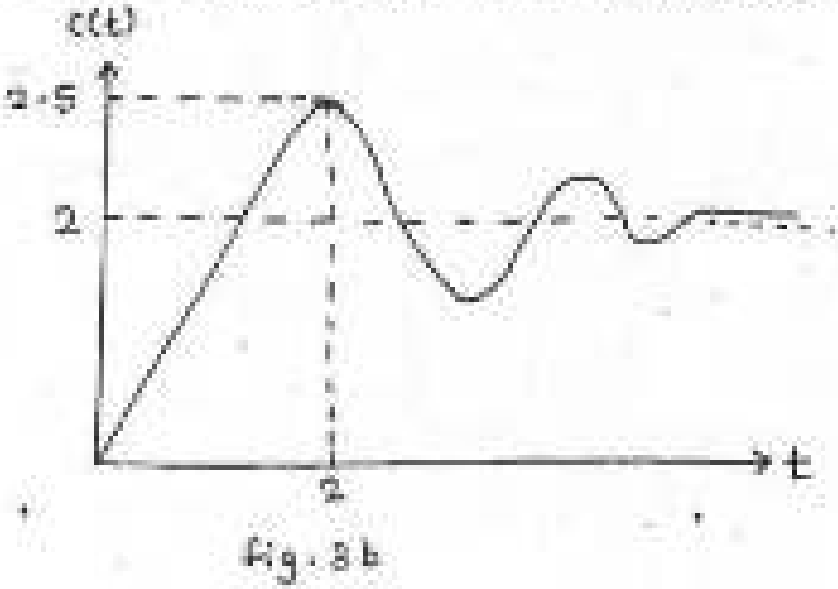

Fig. 3 b

Q4) a) Using Rouths stability criterion, determine the stability of system having its open loop transfer function has poles at S = 0, S = −1, S = −3 and zero at S = −5. Take gain K = 16. [6]

b) Sketch root locus for $G(S)\,H(S) = \dfrac{K(S+2)}{(S+1+j\sqrt{3})(S+1-j\sqrt{3})}$ [10]

Q5) a) Draw bode plot for $G(S) = \dfrac{10}{S(S+1)(S+5)}$ [10]

b) Determine the computer diagram and state space representation for the system shown in fig. 5b, using direct programming. [8]

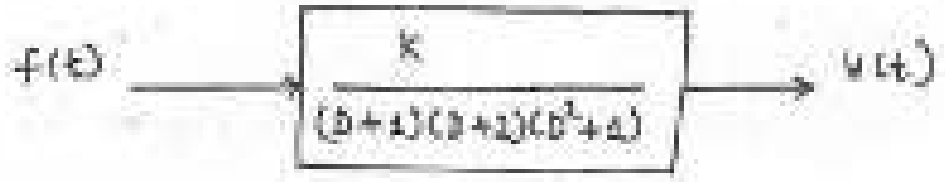

Fig. 5 b

Q6) a) The working of a speed control system is described by the differential eq^n. [8]

$$y(t) = \frac{2(D+5)}{(D+2)(D+3)(D+4)}\, f(t)$$

Determine state space representation and computer diagram by general programming.

b) For a unity feedback system with $G(S) = \dfrac{K(S+1)}{S^2+4S-5}$ [8]

Find

i) angle of departure for complex poles.

ii) entry point for the root locus as it enters the real axis.

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Total No. of Pages : 3

Seat No.	

T.E. (Mechanical) (Semester - V) (Revised) Examination,

December - 2015

THEORY OF MACHINES - II

Sub. Code : 45549

Day and Date : Tuesday, 08 - 12 - 2015 Total Marks : 100

Time : 02.30 p.m. to 05.30 p.m.

Instructions : 1) Attempt any three questions from each Section.
2) Figures to the right indicate full marks.
3) Make suitable assumptions if necessary and state them clearly.

SECTION - I

Q1) a) Derive the equation for maximum efficiency of spiral gears. [7]

b) The centre distance between two meshing spiral gears is 150 mm and the angle between the shafts is 60°. The gear ratio is 2 and the normal circular pitch is 10 mm. The driven gear has a helix of 25°. [9]

Determine :

i) The number of teeth on each wheel.

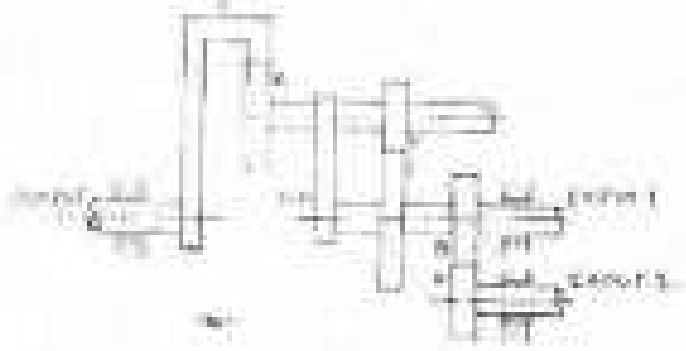
ii) Exact centre distance

iii) efficiency if friction angle is 4°.

Q2) a) Write a note on torques in epicyclic gear trains. [6]

b) An epicyclic gear train is as shown in fig - 1, the input 1 turns at 180 r.p.m. counter clockwise, the input 2 turns at 720 r.p.m. clockwise. Determine the speed and direction of rotation of the out put shaft. The number of teeth on gears are

$T_A = 20$, $T_B = 32$, $T_C = 48$, $T_D = 24$, $T_E = 36$ and $T_F = 108$. [10]



P.T.O.

Q3) a) A shaft carries four A, B, C, D of magnitude 200 kg, 300 kg, 400 kg, 200 kg respectively at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm, and 700 mm. The angles between the cranks measured anti clockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm between X and Y is 400 mm and between Y and D is 300 mm. If the balancing masses revolve at a radius of 100 mm find their magnitudes and angular positions. [12]

b) Explain balancing of V engine. [6]

Q4) a) Explain the terminology of gyroscope and method of finding gyroscopic effect. [6]

b) A rear engine automobile is travelling along a track of 100 m mean radius each of four wheels has Moment of Inertia of 1.5 kg-m^2 and effective diameter of 60 cm. Rotating parts of engine have M.I. of 1 kg-m^2. The engine axis is parallel to rear axle and crank rotates in same sense as road wheels. The back axle ratio is 3:1. The vehicle mass is 1000 kg. and has a C.G. 40 cm. above ground level. Width of track of vehicle is 1.5 m.

Determine limiting speed of vehicle round the curve for all four wheels to maintain contact with road surface if this is not cambered. [10]

SECTION - II

Q5) a) What are the general causes of Vibration? Explain the desirable and undesirable effects of Vibration. [6]

b) A cylinder of mass M and radius r rolls without slipping on a cylindrical surface of radius R. Find the natural frequency for small oscillations about the lowest point. [10]

Q6) a) Derive that the loss of amplitude per cycle for coulomb damping is given by 4F/K, where F is the frictional force and K is Spring stiffness. [8]

b) A 25 kg mass is resting on a spring of 9800 N/m and dashpot of 147 N-sec/m in parallel. If a velocity of 0.10 m/sec applied to the mass at the rest position, what will be its displacement from the equilibrium position at the end of the first second? [8]

Q7) a) What are the types of forcing functions commonly encountered in engineering practice? Derive the equations for steady state response of single degree freedom system consisting of mass M,Spring Stiffness K and damping coefficient C subjected to constant harmonic excitation $F=F_0 \sin \omega t$. [8]

b) A machine of mass 1 tonne is acted upon by an external force of 2450 N at a frequency of 1500 rpm. To reduce the effects of Vibration, isolator of rubber having static deflection 2 mm under the machine load and an estimated damping coefficient 0.2 are used. [8]

Determine:

i) force transmitted to foundation
ii) amplitude of vibration, and
iii) phase lag.

Q8) a) Derive the expression for steady state response of a single degree freedom system involving rotating unbalance. [8]

b) A disc of mass 4 kg is mounted midway between bearings which may be assumed to be simple supports. The bearing span is 50 cm. The steel shaft is of 10 mm diameter and is horizontal. The centre of gravity of the disc is displaced 2 mm from the geometric centre. The equivalent viscous damping at the centre of the disc-shaft may be assumed as 50 N-sec/m. If the shaft rotates at 250 rpm, determine the maximum stress in the shaft. Also find the power required to drive the shaft, at this speed. Take $E = 1.96 \times 10^{11}$ N/m^2. [10]

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S–2083

Total No. of Pages : 3

Seat No.	

T.E. (Mechanical) (Part - III) (Semester - V) Examination, December - 2015

HEAT & MASS TRANSFER

Sub. Code : 45550

Day and Date : Thursday, 10 - 12 - 2015 Total Marks : 100

Time : 02.30 p.m. to 05.30 p.m.

Instructions : 1) Solve any three questions from section I and section II each.
2) Assume suitable data if necessary.
3) Figures to right indicate full marks.

SECTION - I

Q1) a) Define thermal conductivity and discuss thermal conductivity for solids, liquids and gases. [6]

b) A square plate heater (size 20 cm × 20 cm) is inserted between two slabs. Slab A is 2 cm thick (k = 45 w/mk) and slab B is 0.01 m thick (k = 0.2 w/mk). The outside heat transfer coefficient on both sides of A and B are 180 and 50 w/m²k respectively. Temperature of surrounding air is 25°C. If the rating of heater is 1.2 kW. Find. [10]

i) Maximum temperature in the system.

ii) Outer surface temperature of two slabs.

Draw equivalent circuit for system.

Q2) a) A 10 cm OD pipe carrying saturated steam at a temperature of 195°C is lagged to 20 cm diameter with magnesia (k = 0.07 w/mk) and further lagged with laminated asbestos (k = 0.082 w/mk) to 25 cm diameter. If the surrounding air temperature is 15°C and heat transfer coefficient is 20 w/m²k find the mass of steam condensed in 8 hrs in a 100 m length of pipe. Inside heat transfer coefficient is 75 w/m²k. Neglect thermal resistance of pipe material. (Latent heat of evaporation = 1951 kJ/kg). [8]

P.T.O.

b) A hollow cylinder 6 cm ID, 9 cm OD has a heat generation rate of 5×10^5 kw/m^3. Inner surface is maintained at 450°C and outer surface is at 350°C Thermal conductivity of material is 3 w/mk. Determine. [10]

i) Value and location of maximum temperature.

ii) Temperature at midthickness of cylinder.

iii) Sketch the temperature profile.

Q3) a) Derive the expression for temperature distribution in a fin of finite length with insulated end. [8]

b) Define following terms : [8]

i) Emissive power ii) Emissivity

iii) Irradiation iv) Radiosity

Q4) a) Show that the total emissive power of a black surface is equal to Π times the intensity of radiation. [8]

b) A 10 mm OD pipe carries a cryogenic fluid at 80 K. This pipe is encased by another pipe of 15 mm OD and the space between the pipe is evacuated. The outer pipe is at 280 K. Emissivities of inner and outer surfaces are 0.2 and 0.3 respectively. Determine the radiant heat flow rate over a pipe length of 5m. [8]

SECTION - II

Q5) a) What are the natural convection flow patterns? Explain by drawing neat sketches. [8]

b) Calculate the rate of heat loss by natural convection from a outside surface of a vertical pipe of 10 cm outside diameter and 3 m long. The pipe has outside surface temperature of 100°C and surrounding air at 20°C. [8]

Use suitable relation from :

$Nu = 0.1\ (Gr.pr)^{1/3}$ for $10^4 < Gr.\ pr < 10^9$

and $Nu = 0.59\ (Gr.pr)^{1/4}$ for $10^9 < Gr.Pr < 10^{13}$

The properties of air at 60°C are :

$Pr = 0.696$; $k = 0.02896$ w/m.k; $\gamma = 18.97 \times 10^{-6}$ m^2/s

(Q6) a) Discuss 'Dimensional Analysis' as a tool in forced convection to evaluate convective heat transfer coefficient. [8]

b) A motor cycle cylinder consists of 10 fins, each 15 cm outside diameter and 7.5 cm inside diameter. Calculate the rate of heat dissipation from the cylinder fins when the motor cycle is running at 60 km/hr. Use $Nu = 0.036\ (Re)^{0.8}\ (Pr)^{0.33}$. [8]

The atmospheric air is at 20°C & the average fin temperature is 480°C. The thermophysical properties at average temperature of 250°C are :

$\rho = 0.674$ kg/m^3; $Cp = 1038$ J/kg.k, $k = 0.0427$ w/m.k; $Pr = 0.677$; $\gamma = 40.61 \times 10^{-6}$ m^2/s

The approximate value of heat transfer coefficient may be evaluated by considering the fins as a single horizontal flat plate of the same area. Take the characteristic length 'x' = (0.9 × d).

(Q7) a) Derive an expression for effectiveness of parallel flow heat exchanger. [8]

b) The following data is given for counter flow heat exchanger : [8]

$m_h = 1.0$ kg/s; $m_c = 0.25$ kg/s, Cph = 1.045 kJ/kg. °C;

Cpc = 4.18 kJ/kg. °C; Thi = 1000°C, Tco = 850°C; U = 88.5 w/m^2.°C & A = 10 m^2,

Calculate 'Tho & 'Tci'. Take $\varepsilon = 0.48$.

(Q8) Write short notes on (Any Three) [18]

a) Hydrodynamic & thermal boundary layer.

b) Reynold's analogy for laminar flow.

c) Combined free & forced convection.

d) Typical pool boiling curve.

e) Fouling factor.

f) Modes of mass transfer.

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S–2084

Total No. of Pages : 3

Seat No.

T.E. (Mechanical Engineering) (Semester - V) (Revised) Examination, December - 2015

MANUFACTURING ENGINEERING (New)

Sub. Code : 45565

Day and Date : Saturday, 12 - 12 - 2015 Total Marks : 100

Time : 02.00 p.m. to 06.00 p.m.

Instructions : 1) Question No. 1 and Question No. 5 are compulsory.
2) Solve two questions from remaining questions of each section.
3) Figures to the right indicate full marks.
4) Assume suitable data wherever necessary and state it clearly.
5) Use of non programmable calculator is allowed.

SECTION - I

Q1) The component shown in Fig. 1 is to be processed on a single spindle automat. Study the component and prepare [18]

i) Detailed process sheet

ii) Tool Layout

iii) Cam profile for drilling operation

iv) Calculate production rate per hour.

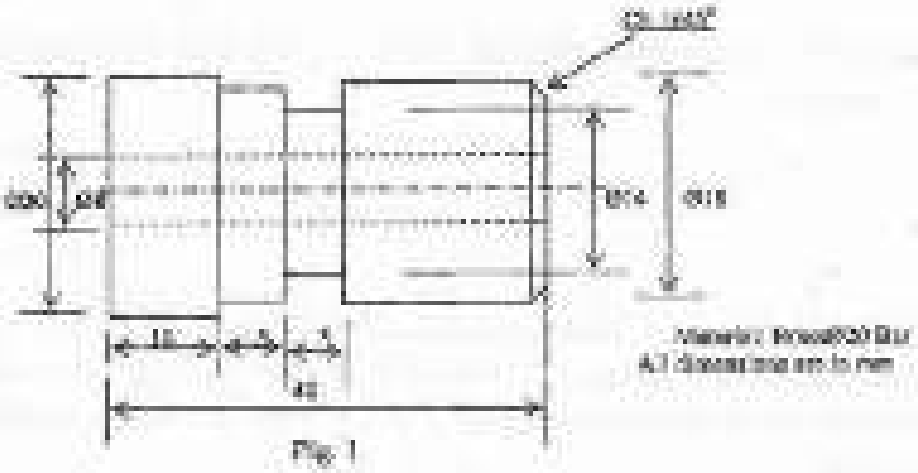


Fig. 1

P.T.O.

(Q2) a) Derive an expression for shear angle. State clearly the assumptions made [8]

b) In an orthogonal cutting operation the followed data have been observed : [8]

chip thickness t = 0.3 mm, Feed = 1.5 mm /rev

Width of cut b = 2.5 mm

Rake angle α = 10°

Cutting force Fc = 1200 N

Feed force Ff = 300 N

Determine

i) Shear angle

ii) Co-eff. Of friction at tool chip interface

iii) Shear stress

(Q3) a) Using Taylor's equation and using n = 0.5 and C = 400. Calculate the percentage increase in tool life when the cutting speed is reduced by 50%. [6]

b) Define machinability. What are the factors affecting machinability? Establish machinsbility based on [10]

i) Cutting force ii) Surface finish

(Q4) a) Explain with neat sketch the tool geometry of single point cutting tool. [8]

b) Explain heat generation in metal cutting and significance of use of coolants. [8]

SECTION - II

(Q5) Design and draw neat dimensional drawing in three views with one sectional view of a jig for drilling two holes ϕ10 as shown in fig.II. Show clearly the details of location, clamping and guiding elements. Assume this as a final operation. [26]

OR

Design and draw neat dimensional drawing in three views with one sectional view of a milling fixture for milling the 10 ± 0.05 mm wide slot at the component shown in fig.II. Show the details of location, clamping and setting of cutter. Assume this as a final operation. [26]

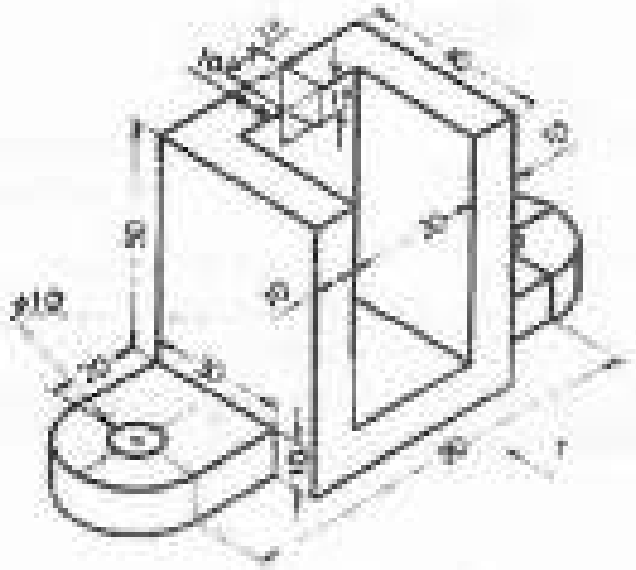


FIG II

Q6) a) Explain the importance of following in press working. [6]
i) Strippers ii) Clearance

b) Explain with neat sketch progressive die. [6]

Q7) a) List the basic methods for replacement and selection of the tools and explain any one method. [6]

b) Explain breakeven point method for selection of machine tools. [6]

Q8) Write short notes on any two. [12]

a) Methods of estimation.

b) Advantages of using jig and fixtures.

c) Diamond locator.

d) Strip layout.

❁❁❁

S–2085

Total No. of Pages : 7

Seat No.	

T.E. (Mechanical) (Part - III) (Semester - V) Examination, December - 2015

MACHINE DESIGN - I

Sub. Code : 45551

Day and Date : Tuesday, 15 - 12 - 2015 Total Marks : 100

Time : 02.30 p.m. to 05.30 p.m.

Instructions : 1) Attempt any three questions from each section.
2) Figures to the right indicate full marks.
3) Draw sketches if required.
4) Assume suitable data & mention the same clearly.

SECTION - I

Q1) a) Give general design procedure for a Machine component. [6]

b) Recommend suitable material for following components with reasons. [6]

i) Surgical Instruments

ii) Keys for Fastening.

iii) Helical spring

c) Enlist different theories of Failure. Explain Maximum principal (Normal) stress theory. [5]

Q2) a) Explain design procedure of turn buckle. [7]

b) Design a right angled bell crank lever. The horizontal arm is 500 mm long and a load of 5 kN acts vertically downward at the end of this arm. A short arm is 100 mm on which force acts. The permissible stresses for lever and pin materials are 75 MPa intension and 60 MPa in shear. Safe bearing pressure is 10 N/mm^2. The lever has rectangular cross-section and ratio of width to thickness is 3:1. The pin length is 1.25 times pin diameter. [10]

P.T.O.

Q3) a) Explain design procedure of bolted joints subjected to eccentric load in shear. [8]

b) A 50 mm diameter solid shaft is welded to a flat plate as shown in Fig. 1. If size of the weld is 15 mm. Find the maximum normal and shear stress in Weld. Refer Sketch. [8]

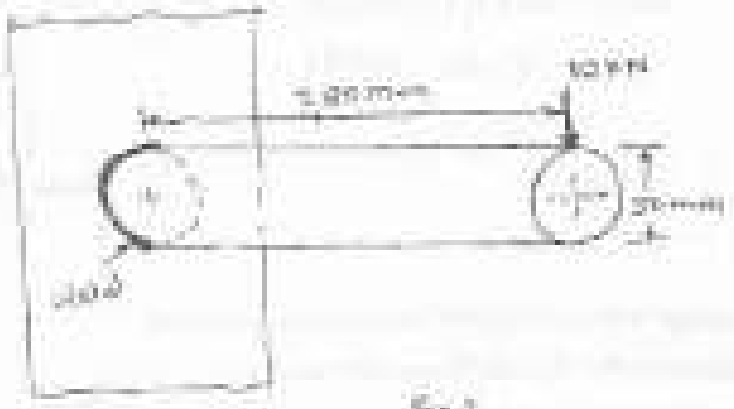


Fig. 1

Q4) a) Explain design procedure of rigid flange coupling with neat sketch. [9]

b) A steel spindle transmits 6 kw at 1200 rpm. The angular deflection should not exceed 0.25° per meter of the spindle. If the modulus of rigidity for the material of spindle is 85 GPa. Find the diameter of the spindle and the shear stress induced in spindle. [7]

SECTION - II

Q5) a) Explain: Wahl factor and it's use in spring design. [6]

b) Safety valve of 50 mm diameter is to blow off at pressure of 1.2 N/mm². It is held on seat by helical spring of spring index 5. Maximum lift of valve is 5 mm. If maximum shear stress limited to 420 N/mm² and modules of rigidity 84×10^3 N/mm². Design spring. [10]

Refer table for wire selection

SWG	4/0	3/0	2/0	0	1
Wire dia mm	10.160	9.490	8.839	8.229	7.620

Q6) a) Draw sketch of recirculating ball screw explain it's working and application. [6]

b) A double start square threaded screw of 80 mm nominal diameter with 10 mm pitch, supports vertical load of 20 kN. Axial thrust on screw is taken by collar bearing of 200 mm outer diameter and 150 mm inner diameter. [10]

Find force required at end of level which is 300 mm long to raise and lower load.

Coefficient of friction for screw is 0.15 and for collar 0.2.

Q7) a) Explain coefficient of fluctuation of speed indicating various values of applications. [7]

b) The turning moment diagram of multicylinder engine is drawn with scale 1 mm = 4.5° on X axis and 1 mm = 70 N.m on Y axis. The intercepted areas between torque developed by engine and mean resisting torque of machine taken in order from are –35, +310, –285, +325, –335, +260, –365, +285, –260 mm². The engine is running at mean speed of 300 RPM. Coefficient of speed fluctuation is limited to 0.02. Rimmed flywheel is made from grey C.I. (FG 200) with mass density 7100 kg/m³. Hub and spokes contributes 10% of required. Moment of inertia. The rim has rectangular cross section with width to thickness ratio 1.5. Find dimensions of rim. [10]

Q8) a) Give various steps to select flat belt from manufacturer's catalogue. [7]

b) Select V belt to connect 15 kw@ 1500 RPM to compressor running at 500 RPM centre to centre distance between shafts is approximatly 1m. Machine is running at 10 Hrs/day. [10]

Select belt specifications, number of belts, correct centre distance and pulley diameters.

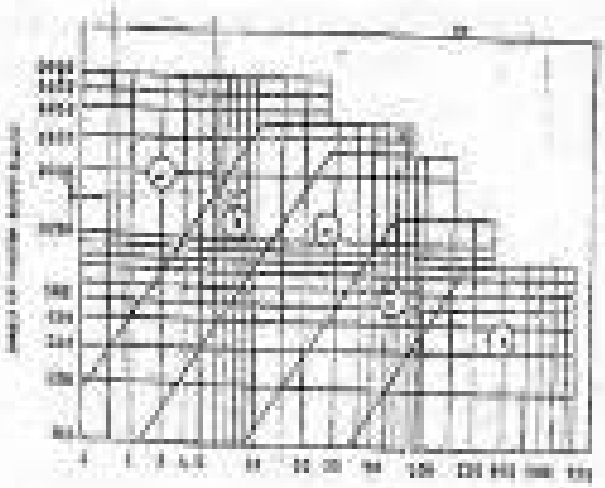
Data for Q.No.8(ii)

Power rating of V-belts

(n_1 = 1875 rpm of the faster pulley; 1440 r.p.m.)

(D = pulley diameter (mm); PR = Power rating in kW)

Section	D	75	80	85	90	100	106	112	118	125
A	PR	0.73	0.86	0.99	1.12	1.39	1.55	1.69	1.82	2.00
Section	D	125	132	140	150	160	170	180	190	200
B	PR	1.29	1.46	1.77	1.90	2.60	4.00	4.38	4.77	5.23
Section	D	200	212	224	236	250	265	280	300	315
C	PR	4.44	4.81	7.84	8.25	8.90	10.10	11.70	12.10	12.90
Section	D	355	375	400	425					
D	PR	15.7	17.5	19.3	20.50					

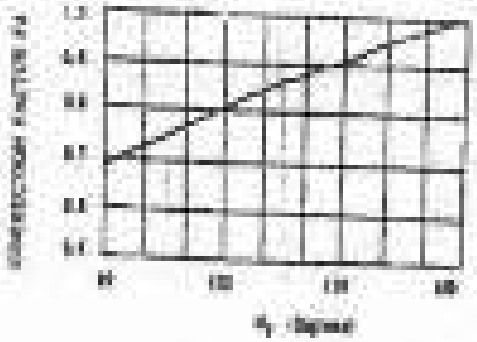


Design power (kW)

Selection of cross-section of V-belt

Correction factor (F_2) for industrial service

Type of service	Operational hours per day		
	0–10	10-16	16-24
1) Light duty; agitators-blowers-centrifugal pumps fans (up to 7.5 kW) and compressors	1.1	1.2	1.3
2) Medium duty; conveyors-fans (above 7.5 kW) line shafts machine tools-presses and positive displacement pumps.	1.2	1.3	1.4
3) Heavy duty; conveyors-bucket elevators and hammers	1.3	1.4	1.5



Correction factor for arc of contact (V-groove on both pulleys)

For 'V' belts

Series of preferred values for pitch diameters (in mm) are as follows:

Pitch diameter (mm) :	125	132	140	150	160	170	180	190	
200	212	224	236	250	265	280	300	315	355	375
400	425	450	475	500	530	560	600	630	670	710
750	800	900	1000							

Dimensions of standard cross-sections

Belt Section	Width W (mm)	Thickness T (mm)	Minimum pitch diameter of pulley (mm)
A	13	8	125
B	17	11	200
C	22	14	300
D	32	19	500
E	38	23	630

Conversion of inside length to pitch length of the belt

Belt Section	A	B	C	D	E
Difference between pitch length and inside length (mm)	36	46	56	79	92

Correction factor F_l for belt length

L_i = nominal inside length of the belt in mm)

L_i	Belt section				
	A	B	C	D	E
1905	1.02	0.97	0.87	–	–
1981	1.03	0.98	–	–	–
2032	1.04	–	–	–	–
2057	1.04	0.98	0.89	–	–
2159	1.05	0.99	0.90	–	–
2286	1.06	1.00	0.91	–	–
2438	1.08	–	0.92	–	–
2464	–	1.02	–	–	–
2540	–	1.03	–	–	–
2667	1.10	1.04	0.94	–	–
2845	1.11	1.05	0.95	–	–
3048	1.13	1.07	0.97	0.86	–
3150	–	–	0.97	–	–
3251	1.14	1.08	0.98	0.87	–
3404	–	–	0.99	–	–
3658	–	1.11	1.00	0.90	–
4013	–	1.13	1.02	0.92	–
4115	–	1.14	1.03	0.92	–
4394	–	1.15	1.04	0.93	–
4572	–	1.16	1.05	0.94	–
4953	–	1.18	1.07	0.96	–
5334	–	1.19	1.08	0.96	0.94
6045	–	–	1.11	1.00	0.96
6807	–	–	1.14	1.01	0.99
7569	–	–	1.16	1.05	1.01

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Total No. of Pages : 3

Seat No.	

T.E. (Mechanical) (Semester - V) (Revised) Examination, December - 2015

CONTROL ENGINEERING

Sub. Code : 66241

Day and Date : Tuesday, 08 - 12 - 2015 Total Marks : 100

Time : 02.30 p.m. to 05.30 p.m.

Instructions : 1) All questions are compulsory.
2) Assume any additional data if required and mention it clearly.
3) Figures to right indicate full marks

Q1) a) For the tank shown in figure 1a, flow is supplied at rate Q_s. Determine the equation for the pressure P (Head H = P/ρ) as a function of P_1 and Q_s. [6]

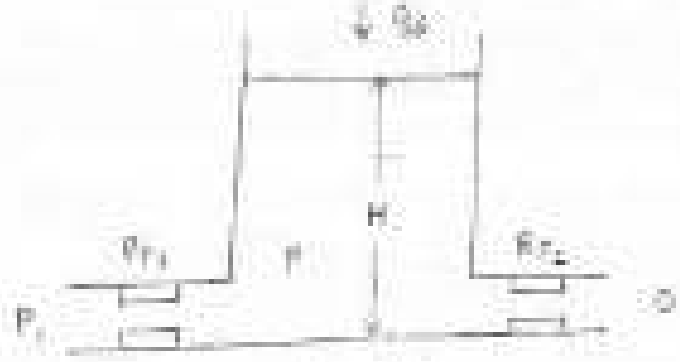

Figure 1 (a)

b) For the mechanical system shown in figure 1b, construct ground chair representation and obtain equation relating f and x. [6]

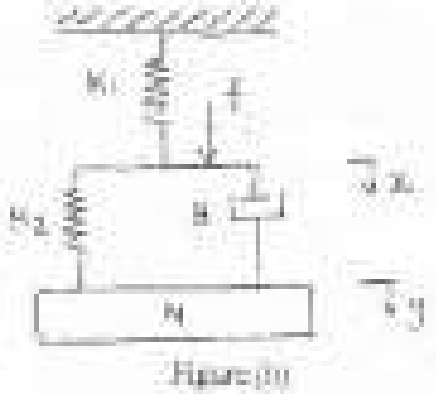

Figure (b)

P.T.O.

c) For the electrical network shown in figure 1.1c construct mechanical system using inverse analog. [6]

Figure 1.1(c)

OR

Obtain mathematical model for gear train. [6]

Q2) a) The equation for the area of the parallelogram is A = W.L.sinθ. Determine the linear approximation for the area A. For Wi = 12, Li = 8 and θi = 60°, what is the approximate area of A when W = 14, L = 9 and θ = 58°. [8]

b Reduce the block diagram shown in figure 2b and find transfer function. [8]

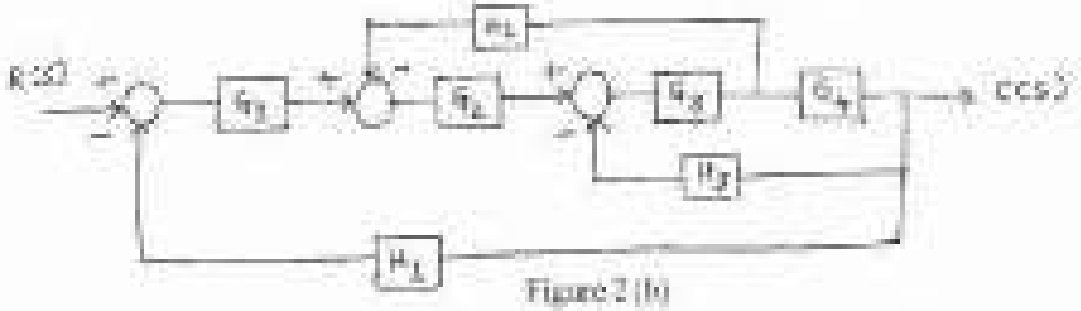

Figure 2 (b)

Q3) a) For the system shown in figure 3a, determine the value of K such that the damping ratio is 0.5. Then obtain rise time, peak time, maximum overshoot and setting time. [8]

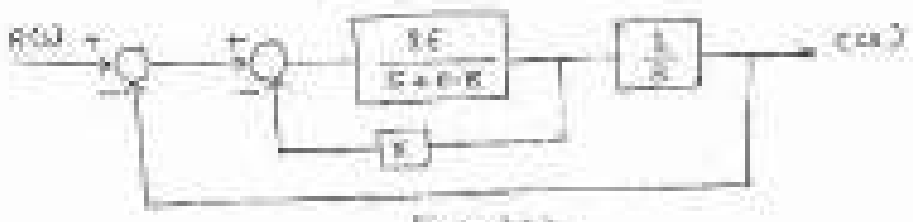

Figure 3 (a)

b) For the spring, mass, damper system shown in figure 5b, obtain response when x (0) = 0, $\dot{x}$(0) = 1, f = 0, M = 1, B = 3 and K = 2. [8]

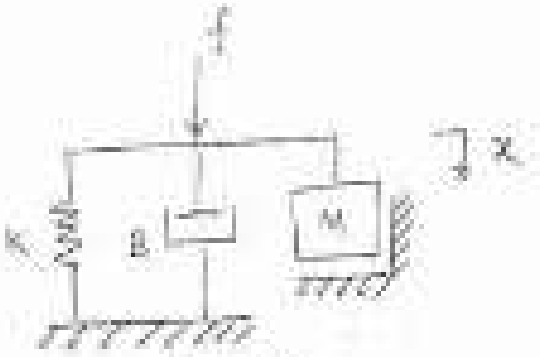

Figure 5 (b)

Q4) a) For the function $G(S)\,H(S) = \dfrac{K(S^2+8S+25)}{(S+1)(S+5)}$ construct root locus with all relevant details. [12]

b) The characteristics equation of feedback control system is $S^4 + 20S^3 + 15S^2 + 2S - K = 0$, determine the range of K for the system to be stable. [6]

Q5) a) Draw Bode plot for the transfer function

$$G(S)\,H(S) = \frac{50}{S(S+0.25S)(1+0.1S)}$$ From the graph determine. [8]

i) Gain margin

ii) Phase margin

b) Write a short not on Polar plot. [8]

Q6) a) For the differential equation $(D+3)(D+4)\,y(t) = (D+6)\,f(t)$, construct computer diagram and state space representation using direct programming. [8]

b) Construct computer diagram and state space representation using general programming for system represented by differential equation $(D+2)(D+5)\,y(t) = (D^2+3D+10)\,f(t)$. [8]

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Total No. of Pages : 4

Seat No.	

T.E. (Mechanical) (Semester - V) Examination, December - 2015

CONTROL ENGINEERING (Pre Revised)

Sub. Code : 48709

Day and Date : Thursday, 17 - 12 - 2015 Total Marks : 100

Time : 02.30 p.m. to 05.30 p.m.

Instructions: 1) Attempt any three questions from section - I and section - II.
2) Assume any additional data if required and mention it clearly.
3) Figures to the right indicates full marks

SECTION- I

Q1) a) Construct mechanical system using force voltage analog for the electrical network shown in figure 1a. [6]

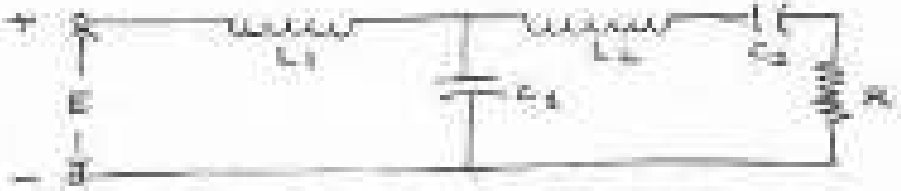

Figure 1 - a

b) Explain torsional system with neat sketch and write equation between torque and angular displacement. [6]

c) Draw free body diagram and write the differential equations of the system shown in figure 1c. [6]

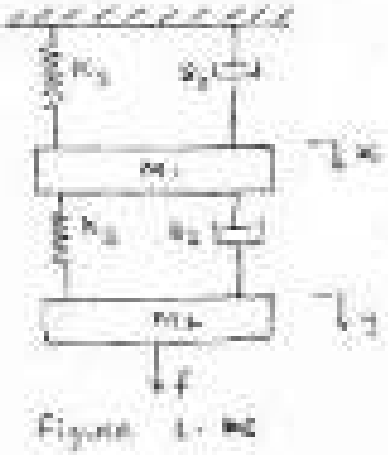

Figure 1 - c

P.T.O.

(Q2) a) Linearise the equation $V = \frac{D}{T}$, where V is velocity, D is displacement and T is time. Determine the linear approximation for v due to change in d and change in t. [8]

b) Reduce the block diagram shown in figure 2 b and find transfer function. [8]

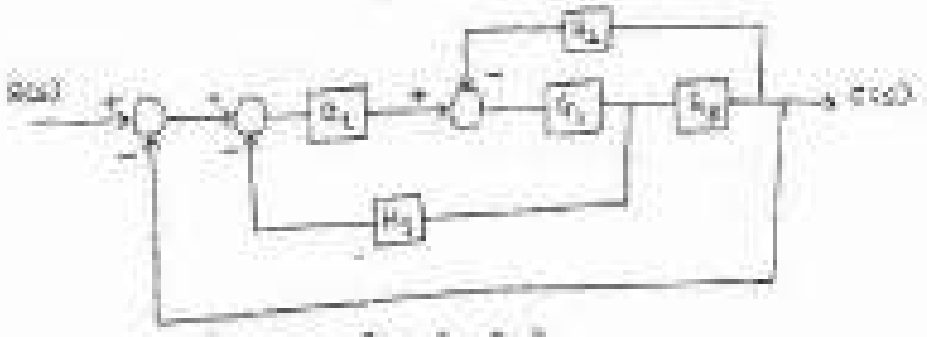

Figure 2-b

(Q3) a) A controller is to be designed for a system such that the output c will not change by more than 1 unit when the load changes by 10 units. The steady state operating curves for the system to be controlled have a slope of 5 units. What is the required slope of the controller lines when B = – 0.3 [8]

b) For the system shown in figure 3 b, determine K_1 and K_2 so that the system will have a steady state gain of 1 and a time constant of 0.5 sec. [8]

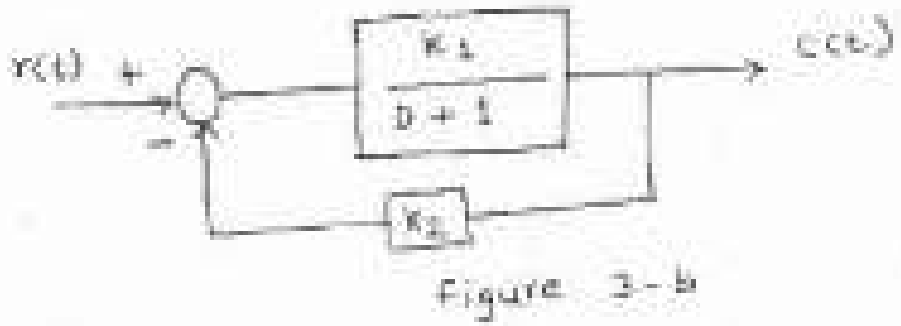

Figure 3-b

(Q4) a) With neat sketch, explain the operation of hydraulic servomotor and determine the overall block diagram representation. [8]

b) Derive transfer function relation for AC and DC tachometers. [8]

SECTION - II

(Q5) a) The block diagram of a unity feedback control system is shown in figure 5 a. Draw the root locus diagram for the control system. [12]

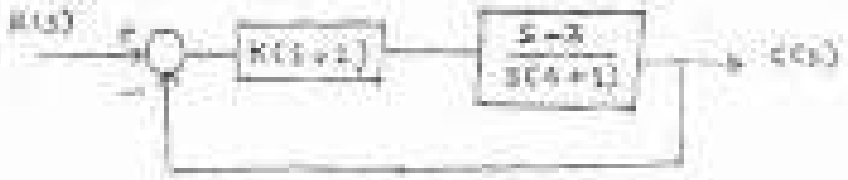

Figure 5 - a

b) The characteristics equation for certain system is $(s^4 + 4S^3 + 3S + K) = 0$. Determine the value of K for marginal stability. Also find the frequency value above which system becomes unstable. [6]

(Q6) a) Obtain unit step response of a unity feedback system having an open loop transfer function $G(S) \frac{4}{S(S+3)}$. Consider all initial conditions as zero. [8]

b) For the system shown in figure 6 b, determine damping ratio and natural frequency, if the time constant T is 3 sec and ratio of torque to inertia (K/J) is 2/9 rad²/sec². [8]

Figure 6 - b

(Q7) a) For the series RLC circuit shown in figure 7 a, determine the equation for damping ratio and natural frequency. [8]

Figure 7 - a

b) Determine response c(t) of the system shown in figure 7 b, when K = 1, r(t) = $2e^{-3t}$ and C(0) = C(0) = 0 [8]

Figure 7 - a

(OR) a) A system is described by the differential equation [8]

$\frac{d^3y}{dt^3}+\frac{6d^2y}{dt^2}+\frac{11dy}{dt}+6y=3.\ u(t)$ where y is the output and u is the input to the system. Obtain the state space representation and draw computer diagram using direct programming.

b) The system equations are given by $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}u(t)$ & $c(t)=[1\ 0]\begin{bmatrix}x_1\\ x_2\end{bmatrix}$

Find transfer function. [8]

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Total No. of Pages : 3

Seat No.	

T.E. (Mechanical Engineering) (Semester - V) (Revised) Examination, December - 2015

THEORY OF MACHINES - II

Sub. Code : 66242

Day and Date : Thursday, 10 - 12 - 2015 **Total Marks : 100**

Time : 02.30 p.m. to 05.30 p.m.

Instructions:
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat labeled sketch wherever necessary.
4) Assume if necessary suitable data and state clearly.
5) Use of non programmable calculator is permitted.

Q1) a) Derive the expression for the length of path of contact with usual notations. [8]

OR

Derive an expression for minimum number of teeth required on pinion to avoid interference in mesh with gear.

b) A pair of 20° full depth involute spur gears having 30 and 50 teeth respectively of module 4 mm are in mesh. The smaller gear rotates at 1000rpm. Determine [10]

i) length of path of contact,

ii) contact ratio.

Q2) a) Explain the torques in epicyclic gear train. [6]

OR

Write a note on Inertia geared system.

b) An epicyclic gear train consists of three wheels A, B and C as shown in fig. 2b. Wheel A has 72 internal teeth, C has 32 external teeth. The wheel B gears with both A and C and is carried on an arm which rotates about the centre of A at 18 rpm. If the wheel A is fixed, determine the speed of wheels B and C. [10]

Fig. for 2b

P.T.O.

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Total No. of Pages : 3

Seat No.	

T.E. (Mechanical Engineering) (Semester - V) (Revised) Examination, December - 2015

THEORY OF MACHINES - II

Sub. Code : 66242

Day and Date : Thursday, 10 - 12 - 2015 Total Marks : 100

Time : 02.30 p.m. to 05.30 p.m.

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat labelled sketch wherever necessary.
4) Assume if necessary suitable data and state clearly.
5) Use of non programmable calculator is permitted.

Q1) a) Derive the expression for the length of path of contact with usual notations. [8]

OR

Derive an expression for minimum number of teeth required on pinion to avoid interference in mesh with gear.

b) A pair of 20° full depth involute spur gears having 30 and 50 teeth respectively of module 4 mm are in mesh. The smaller gear rotates at 1000rpm. Determine [10]

i) length of path of contact,

ii) contact ratio

Q2) a) Explain the torques in epicyclic gear train. [6]

OR

Write a note on harrile geared system.

b) An epicyclic gear train consists of three wheels A, B and C as shown in fig. 2b. Wheel A has 72 internal teeth, C has 32 external teeth. The wheel B gears with both A and C and is carried on an arm which rotates about the centre of A at 18 rpm. If the wheel A is fixed, determine the speed of wheels B and C. [10]

Fig. No. 2b

P.T.O.

Q3) a) Derive the expression for gyroscopic couple magnitude. [6]

b) A racing car weighs 20kN. It has a wheel base of 2 m, track width 1m and height of C.G is 0.30 m above the ground level and lies midway between the front and rear axle. The engine flywheel rotates at 3000 rpm clockwise when viewed from the front. The moment of inertia of the flywheel is 4 kg-m^2 and moment of inertia of each wheel is 3kg-m^2. Find the reactions between the wheels and the ground when the car takes a curve of 15m radius towards right at 30km/hr, taking into consideration the gyroscopic and centrifugal effects. Each wheel radius is 0.40m. [10]

Q4) a) Derive an expression for velocity and acceleration of the slider of slider crank mechanism. [6]

OR

Explain dynamically equivalent system to replace connecting rod by a two mass system.

b) The connecting rod of a vertical reciprocating engine is 2 m long between centres and weighs 250 kg. The mass centre is 850 mm from the big end bearing. When suspended as a pendulum from the gudgeon pin axis, it makes 8 complete oscillations in 22 seconds. Calculate the radius of the gyration of the rod about an axis through its mass centre. The crank is 400 mm long and rotates at 200 rpm. Find the inertia torque exerted on the crankshaft when the crank has turned through 40° from the top dead centre and the piston is moving downwards. [10]

Q5) a) Explain direct and reverse crank method for balancing of the radial engine. [6]

OR

Explain partial balancing of unbalanced primary force in a reciprocating engine.

b) Four masses A, B, C, and D as shown below are to be completely balanced. [12]

	A	B	C	D
Mass (kg)	–	30	50	40
Radius (mm)	180	240	120	150

The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90°, B and C make angles of 210° and 120° respectively with D in the same sense.

Find:

i) The magnitude and the angular position of mass A_1 and

ii) The positions of planes A and D.

Q6) a) Derive expression for energy stored in a flywheel. [6]

b) The turning moment diagram for a multi-cylinder engine has been drawn to a scale of 1 mm to 500 N-m torque and 1 mm to 8° of crank displacement. The intercepted areas between output torque curve and mean resistance line taken in order from one end in sq. mm are -

$-30, +410, -280, +320, -330, +250, -360, +280, -260$ sq.mm,

when the engine is running at 800 rpm. The engine has a stroke of 300 mm and the fluctuation of the speed is not to exceed 2 % of the mean speed. Determine the suitable diameter and cross-section of the rim flywheel rim for a limiting value of the safe centrifugal stress of 7 MPa. The material density may be assumed as 7200 kg/m³. The width of the rim is to be 5 times the thickness. [10]

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Total No. of Pages : 7

Seat No.	31132

T.E. (Mechanical) (Part - III) (Semester - V) (Revised) Examination, December - 2015

MACHINE DESIGN - I

Sub. Code : 66244

Day and Date : Tuesday, 15 - 12 - 2015 Total Marks : 100

Time : 02.30 p.m. to 05.30 p.m.

Instructions : 1) All questions are compulsory.

2) Figures to the right indicate full marks.

3) Make suitable assumptions wherever required and state them clearly.

4) Use of non-programmable calculator is permitted.

5) Draw neat diagrams wherever necessary.

Q1) Solve any Three : [18]

a) How material is selected while designing a machine element?

b) State different theories of failure. Define any three.

c) Explain the design procedure for a cam buckle with the help of neat sketch.

d) Explain the design procedure of bolted joint subjected to eccentric load in plane containing bolts.

P.T.O.

Q2) a) Figure 2a shows a bell-crank lever, used to drive the air pump of a condenser. A force of 5kn acts at A as shown. Determine [8]

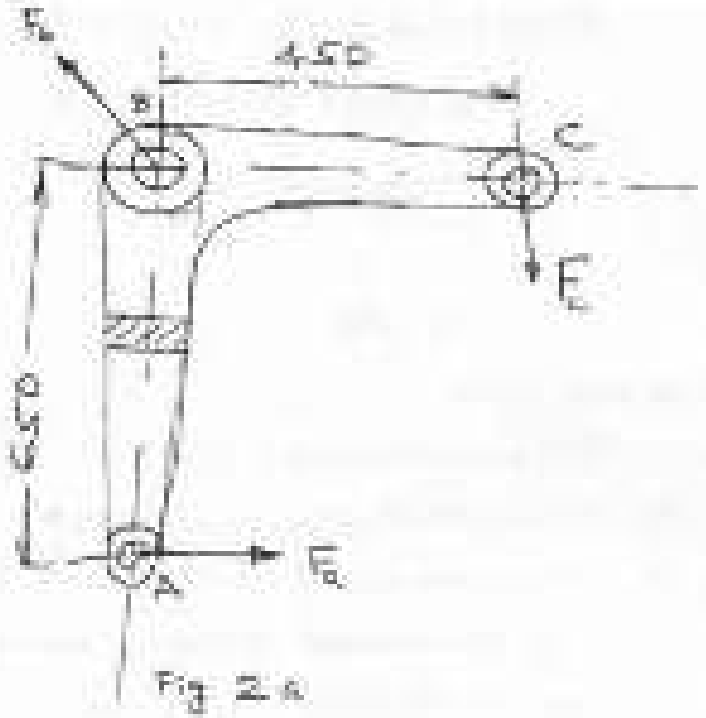

Fig 2.a

i) The forces at the fulcrum, B and at C

ii) The diameter of pins at A,B and C(Assume that the ends A and C are forked and the pin at B is overhung).

iii) The cross section of the lever near the fulcrum.

Use the following stress values for both the lever and pin material.

Permissible stress in tension = 80MPa

Permissible stress in shear = 45MPa

Permissible bearing pressure = 10MPa

b) Figure 2b shows a pulley bracket, which is supported by 4 bolts, 2 at end A and 2 at end B. The weight of pulley and bracket, W is 850N, and the load, F on the rope is 20kN. Determine the size of the bolts, using an allowable shear stress of 40 MPa for the bolt material. [8]

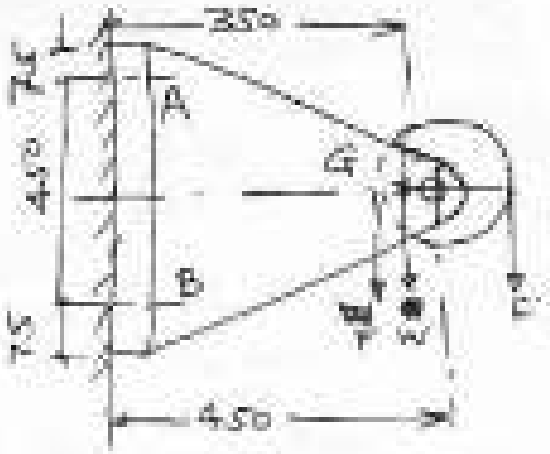

Fig 2.b

OR

b) A welded connection as shown in figure 2c is subjected to the eccentric force of 7.5kN. Determine the size of welds if the permissible shear stress for the weld is 100N/mm^2. Assume static conditions.

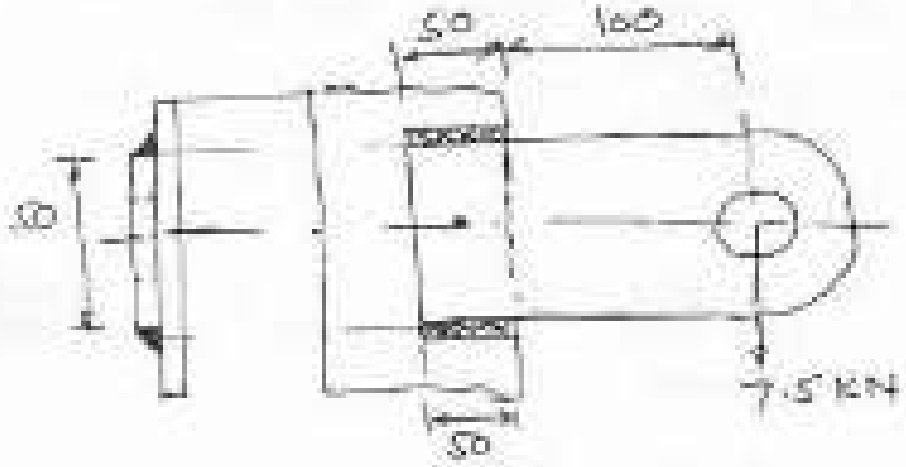

Fig 2.C

(23) a) What are the different types of coupling? Discuss the design procedure for muff coupling. [6]

b) A splined connection with the following particulars is used for a gear and shaft assembly in a gear box. The power to be transmitted is 20 kW at 240 r.p.m. The bearing pressure on the splines is limited to 6.3MPa during sliding. The coefficient of friction is 0.12. [10]

Major diameter = 60mm

Minor diameter = 54mm

Number of splines = 10

Determine :

i) The length of gear hub

ii) The force required to shift the gear.

OR

b) A protective flange coupling is used to connect two shafts and transmits 7.5 kW of power at 720 r.p.m. The design torque is 150% of rated torque. The shafts and bolts are made of plain carbon steel 30C8

(S_{yt} = 400N/mm², factor of safety = 3.00).

Assume $S_{yc} = 1.5S_{yt}$ and $S_{ys} = 0.5S_{yt}$. The flanges are made of cast iron.

Calculate

i) Diameter of shafts

ii) Number of bolts

iii) Diameter of the bolts

Draw proportionate sketch of the flange indicating dimensions with their proportions.

Q4) a) What are the various types of springs used in practice? Explain one application of each. [6]

b) Safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm^2. It is held on its seat by closed coil helical spring. The maximum lift of valve is 10 mm. Design a suitable compression spring of spring index 5 and providing an initial compression of 35 mm. The maximum shear stress in the material of wire is limited to 500 N/mm^2. The modulus of rigidity for spring material is 80 kN/mm^2. Calculate : [10]

i) Diameter of spring wire

ii) Mean coil diameter

iii) Number of active turns and

iv) Pitch of the coil

Assume Whal's Stress factor $K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$

Standard wire gauge (SWG) number and corresponding diameter of spring wire is given in the following table,

SWG	4/0	5/0	6/0	7/0
Diameter (mm)	10.160	10.973	11.785	12.70

Q5) a) What do you understand by overhauling and self locking of power screw? Hence deduce the condition for self locking screw. [6]

OR

Discuss various forms of threads used for power transmission giving their relative merits and limitations.

b) The power transmission screw of a screw press is required to transmit maximum load of 100 kN and rotates at 60 RPM. The trapezoidal threads are to be used as under: [12]

Nominal Dia. mm	40	50	60	70
Core Dia.mm	32.50	41.50	50.50	59.50
Mean Dia. mm	36.50	46.00	55.50	65.00
Core Area mm^2	830	1353	2003	2781
Pitch mm	7	8	9	10

The screw thread friction coefficient is 0.12.The torque required for collar friction and journal bearing is about 10% of the torque to drive the load considering screw friction. Determine screw dimensions and its efficiency. Also determine the motor power required to drive the screw. The maximum permissible compressive stress in the screw is 100 MPa.

Q6) a) Explain the step by step procedure for selection of V-belt from Manufacturer's Catalogue. [6]

b) It is required to select flat belt drive for a fan running at 360 rpm which is driven by a 10 kW 1440 rpm motor. The belt drive is open type and space is available for a center distance of 2 m approximately. The belt should operate at velocity between 17.80 m/s to 22.90 m/s. The power transmitting capacity of the belt per mm width per ply at 180° arc of contact and at a belt velocity of 2.09 m/s is 0.0118 kW. The load correction factor can be taken as 1.2. Suggest preferred pulley diameters for the motor and fan pulleys and give complete specifications of belting. Refer the tables given below. [10]

Arc of Contact Factor (F_θ)

θ_c (Deg)	130	140	150	160	170	180	190	200
F_θ	1.25	1.19	1.13	1.08	1.04	1.00	0.97	0.94

Standard Widths of these belts in mm

3-Ply	25	40	50	63	76					
4-Ply	40	44	50	63	76	90	100	112	125	152
5-Ply	76	100	112	125	152					
6-Ply	112	125	152	180	200					

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Total No. of Pages : 3

Seat No.

T. E. (Mech.) (Part - III) (Semester - V) Examination, December - 2015

HEAT AND MASS TRANSFER

Sub. Code : 66243

Day and Date : Saturday, 12 - 12 - 2015 Total Marks : 100

Time : 02.30 p.m. to 05.30 p.m.

Instructions : 1) All Questions are compulsory.
2) Figure to the right indicates full marks.
3) Assume suitable data wherever necessary and state it clearly.
4) Use of scientific calculators is permitted.

Q1) a) Write the basic laws of Heat Transfer. [6]

b) Write the general heat conduction equation in Cartesian, Cylindrical and Spherical coordinates. [4]

c) An Exterior wall of a house consists of a 10.16 cm layer of common brick having thermal conductivity 0.7 W/mK. It is followed by 3.8 cm layer of gypsum plaster with thermal conductivity 0.48 W/mK. What thickness of loosely packed Rockwool insulation (k = 0.063 W/mK) should be added to reduce the heat transfer through the wall by 80%?[8]

Q2) a) Solve any one of the following. [8]

i) From the general heat conduction equation in cylindrical coordinate system, and deduce the equation in one dimensional Poison's equation and derive the equation for temperature distribution and heat transfer for a solid cylinder.

ii) Write the general heat conduction equation in Cartesian, cylindrical and spherical coordinate system, also deduce the equation in one dimensional Poison's equation and derive the equation for temperature distribution and heat transfer for a slab.

P.T.O.

b) A plane wall (k = 45 W/mK), 10 cm thick generates heat at a uniform rate of 8×10^6 W/m^3. The two sides of the wall are maintained at 180°C and 120°C, calculate (i) Temperature distribution across the plane wall, and (ii) location and magnitude of the highest temperature in the wall. [8]

Q3) a) Solve any one of the following. [8]

i) What are the initial and boundary conditions? What are their types? Explain with suitable examples.

ii) Define fin efficiency and effectiveness, derive the equation for fin efficiency for a fin with insulated tip.

b) The steam at 300°C is passing through a steel tube. A thermometer pocket of steel (k = 45 W/mK) of diameter 16 mm and 1 mm thick is used to measure the temperature. Calculate the length of the thermometer pocket needed to measure the temperature within 1.8% permissible error. Take heat transfer coefficient 90 W/m^{2}K, and tube wall temperature as 100°C. [8]

Q4) a) Explain phenomenon Natural convection and Forced convection. [4]

b) Explain thermal boundary layer with the help of neat sketch. [4]

c) A water is heated while flowing through 1.5 cm × 3.5 cm rectangular cross section tube at velocity of 1.2 m/s, the inlet temperature of water 40°C. And the tube wall is maintained at 85°C. Determine the heat transfer coefficient, take properties of water at bulk mean temperature as Density = 985.5 kg/m^3, k = 0.654 W/mK, C_p = 4.18 kJ/kgK, Kinematic Viscosity= 0.5 17 × 10^{-6}m^2/s, Pr = 3.26 Assume Nu = 0.023 $Re^{0.8}Pr^{0.3}$ [8]

Q5) a) Explain the terms i) Radiosity ii) Irradiation. [4]

b) Derive expression of shape factor for cylindrical cavity with diameter D and height H. [6]

OR

b) Derive Stefan Boltzman law from Planck's law

c) Assuming sun to be black body having surface temperature of 5800 k. Calculate i) Total emissive power ii) Wavelength at which monochromatic emissive power is maximum iii) Maximum value of monochromatic emissive power [8]

(Q6) a) Explain dropwise and filmwise condensation with neat sketch. [4]

b) What do you mean by fouling factor? What are the causes of fouling? [4]

c) A counter flow heat exchanger is employed to heat air entering at 400°C with a flow rate of 6 kg/s by exhaust gas entering at 900°C with a flow rate of 4 kg/s. The overall heat transfer coefficient is 100 W/m²K and the outlet temperature of air is 551.5°C. The specific heat at constant pressure for both air and exhaust gas can be taken as 1100 J/kg.K. Calculate; i) Heat transfer area needed ii) Number of transfer units. [8]

OR

Water at 225 kg/h is to be heated from 35°C to 95°C by means of concentric tube heat exchanger. Oil at 225 kg/h and 210°C with a specific heat of 2093 J/kgK is to be used as hot fluid. If the overall heat transfer coefficient based on outer diameter of inner tube is 550 W/m²K. Determine the length of heat exchanger, if the outer diameter is 100mm. [8]

● ● ●

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Seat No.	

Total No. of Pages : 3

T.E. (Mechanical) (Part - I) (Semester - V) Examination, December - 2015

METROLOGY AND QUALITY CONTROL

Sub. Code : 45564

Day and Date : Saturday, 19-12-2015.

Time : 02.30 p.m. to 05.30 p.m. Total Marks : 100

Instructions : 1) Answer any three questions from each section.
2) Figures to the right indicate full marks.
3) Draw neat labeled sketches wherever necessary.
4) Assume if necessary suitable data and state them clearly.
5) Use of non-programmable calculators is allowed.

SECTION - I

Q1) a) Describe the various sources of errors in measurement. [6]

b) Explain Taylor's principle of gauge design. [6]

c) Enumerate the advantages of wavelength standards. [4]

Q2) a) Draw a neat sketch of Sigma comparator and explain its working. [8]

b) State the precautions to be taken while using slip gauges. [8]

Q3) a) Explain the principle of measurement by light wave interference. [8]

b) Explain the use of mechanical bevel protractor in angle measurement. [8]

Q4) Write short notes on (any three). [18]

a) Abbe's principle of alignment

b) Snap gauges

c) Spirit level

d) Angle Dekkor

e) Level beam comparator

P.T.O.

SECTION - II

Q5) a) What are the different methods for the measurement of effective diameter of screw thread. [8]

b) Explain with figure the working and use of gear tooth vernier caliper. [8]

Q6) a) Differentiate between quality control and quality assurance. [8]

b) Explain the concept of balance between cost of quality and value of quality. [8]

Q7) a) Discuss chance causes and assignable causes of variation. [6]

b) Following data was obtained for diameter of a component from shop floor. Construct X-bar and R charts and state whether the process is in control or not. [10]

Sample No.	X_1	X_2	X_3	X_4	X_5
1	43	61	64	69	72
2	46	54	67	71	79
3	18	23	74	76	81
4	37	49	56	67	70
5	41	44	64	70	74
6	21	24	23	45	51
7	56	61	61	62	84
8	33	38	40	46	71
9	24	34	46	51	66
10	33	38	40	49	58

For sample size = 5 take $A_2 = 0.577$, $D_2 = 2.114$, $D_1 = 0$.

Q8) Write short notes on (any three). [18]

a) CLA method for measurement of surface roughness

b) Different errors in screw threads

c) Measuring of composite errors in gears

d) Operating characteristic curve

e) Single and double sampling plan

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Total No. of Pages : 3

Seat No.	

T.E. Mechanical (Semester - V) (Revised) Examination, December - 2015

MANUFACTURING ENGINEERING

Sub. Code : 66245

Day and Date : Thursday, 17 - 12 - 2015 Total Marks :100

Time : 1.30 p.m. to 05.30 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to right indicate full marks.
3) Assume if necessary suitable data and state them clearly.
4) Use of non-programmable calculators is permissible.

Q1) Solve any two

a) Explain different types of tool materials. List important properties of tool materials. [8]

b) Explain orthogonal and oblique cutting operation with neat sketch.[8]

c) During orthogonal turning operation of C40 steel with carbide cutting tool, following observations were made. Cutting force =3000N, Feed force = 2000N, Rake angle = 10°, chip thickness ratio= 0.35. Find out Shear plane angle. Coefficient of friction between chip and tool interface and friction angle. [8]

Q2) Solve any two.

a) Explain concept of heat generation in metal cutting and use of coolants.[8]

b) Draw neat sketch of a single point cutting tool and explain different angles provided on single point cutting tool . [8]

c) While machining C40 steel with HSS tool at a feed rate of 0.2 mm/rev. and 2 mm depth of cut, following observations were noted.

Cutting speed (m/min):	25	35
Tool life (hours):	1.5	0.333

Assuming Taylor's equation as $V.T^n$ = constant, recommend the cutting speed for tool life of 1 hour. [8]

P.T.O.

Q3) The component shown in fig. 1 is to be processed on a single spindle automat. Study the component and prepare: [18]

All dimensions are in mm.

Fig. 1 : Material - M. S. polish bar ϕ 25.

a) Detailed process sheet.

b) Tool layout

c) Cam profile for drilling operation

Q4) Solve any one

a) Design and draw neat dimensional drawing in three views with one sectional view of a jig for drilling two holes ϕ20 as shown in figure 4a. Show clearly the details of location, clamping and guiding elements. Assume this as a final operation. [26]

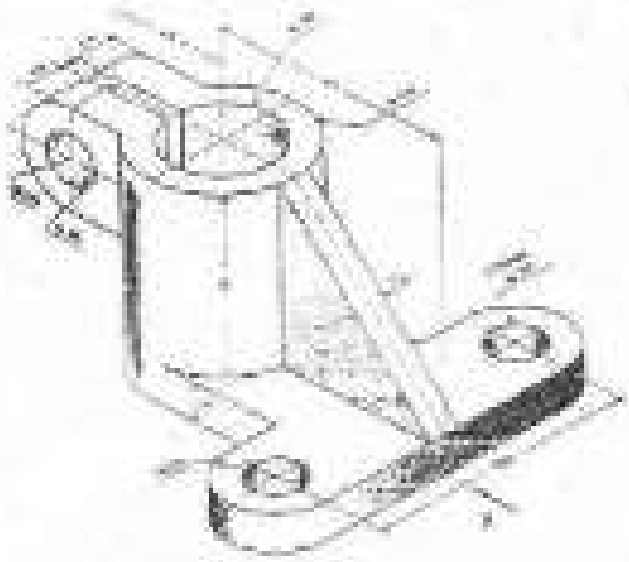

Fig.4a

b) Design and drew a neat dimensional sketch in three views with one sectional view of a milling fixture, for milling the surface marked (√) as shown in figure. Show clearly details of location, clamping of work piece and guiding of cutter. Assume this as a final operation. [26]

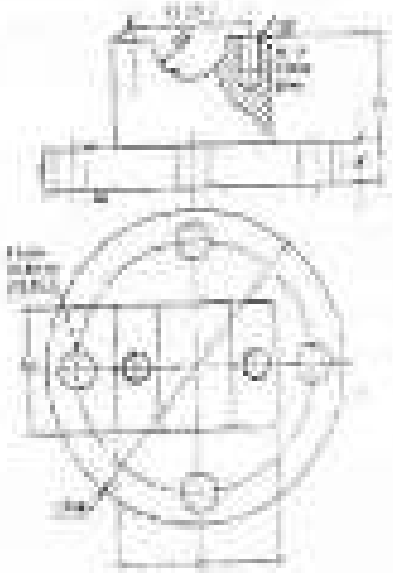

Fig P

(Q5) Solve any two [12]

a) Explain with neat sketch nomenclature of press tool. [6]

b) A washer with a 12.7 mm internal hole and outside diameter of 25.4 mm is to be made from 1.5 mm thick strip of 0.2 % carbon steel. Considering the elastic recovery of material, find: 1) The clearance. 2) Piercing punch size and. 3)Piercing die opening size. [6]

c) Write design considerations for die element. [6]

(Q6) Write Short notes on any three [12]

a) Construction and working of CNC

b) Automatic tool changers

c) Modular Tooling systems

d) Comparison between NC and CNC Machines

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Total No. of Pages : 3

Seat No.	

T.E. (Mech.) (Semester - V)
Examination, November - 2019
CONTROL ENGINEERING
Sub. Code : 66241

Day and Date : Friday, 22 - 11 - 2019 Total Marks : 100

Time : 2.30 p.m. to 5.30 p.m.

Instructions : 1) All the questions are compulsory.
2) Assume suitable data wherever required and mention it clearly.

Q1) a) For mechanical system shown in fig. below, determine the eqⁿ which relates [6]

i) x to f ii) y to f iii) y to x

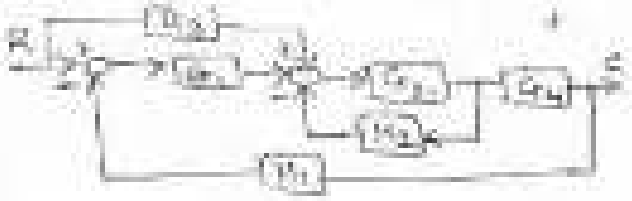
b) For the electrical system shown in fig. below, construct mechanical system which is in direct analog. [6]

c) Write electrical analogy for fluid systems and explain in detail. [6]

P.T.O.

Q2) a) Effect a linear approximation for $T=2\pi\sqrt{\frac{L}{G}}$. For L = 100 and G = 32.2, determine the change in the period due to an increase in L of 1 and decrease in G of 0.1. [8]

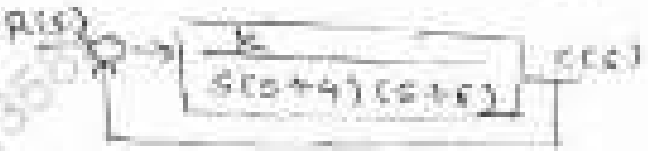
b) Reduce the block diagram and find the transfer function. [8]



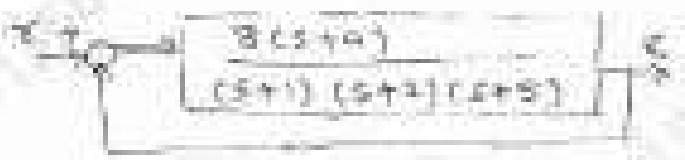
Q3) a) The forcing function is f(t) = u(t) and all initial conditions are zero. Determine the response c(t) of system [8]

b) For control system shown in fig. Determine K_1, K_2 and 'a' such that system will have a steady state gain of 1, a natural frequency of '2' and damping ratio of 0.5. [8]

Q4) a) Construct root locus plot for [12]



b) Determine value of 'k' such that system is stable [6]



Q5) a) Sketch the Bode plot for the transfer function

$$G(S)=\frac{1000}{S(1+0.1S)(1+0.01S)}$$

Determine gain margin and phase margin. [10]

b) Find the break in point and angle of departure for the control system given by characteristic equation

$$1+\frac{K(S+1)}{S^2+4S+13}=0$$ [6]

Q6) a) Determine state space representation & computer diagram using series method

$$y(t)=\frac{D+8}{D(D^2+8D+20)}\,f(t)$$ [8]

b) Determine state space model and computer diagram using general method

$$y(t)=\frac{D+10}{(D^2+7D+10)}\,f(t)$$ [8]

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Total No. of Pages : 3

Seat No.	

T.E. (Mechanical Engineering) (Part - III) (Semester - V) Examination, November - 2019

THEORY OF MACHINES - II

Sub. Code : 66242

Day and Date : Monday, 25 - 11 - 2019 Total Marks : 100

Time : 2.30 p.m. to 5.30 p.m.

Instructions :
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Make suitable assumptions wherever required and state them clearly.
4) Use of non-programmable calculator is permitted.
5) Draw neat diagrams wherever necessary.

Q1) a) Derive the expression for the minimum number of teeth required on pinion to avoid interference in mesh with gear.

OR

Prove that velocity of sliding is proportional to the distance of the point contact from the pitch point. [8]

b) A 20° involute gear of 8 mm module with 50 teeth is driven by a pinion of 20 teeth. If the contact ratio is to be maximum without interference, find the addendum of pinion, gear, length of path of contact and contact ratio. [10]

Q2) a) An epicyclic gear train consists of sun, planet, arm and annular gear. Derive the equation of velocity ratio.

OR

A geared system consists of three gears A, B, C with T_A, T_B, and T_C teeth forming a simple gear train. Derive the equation of inertia torque applied to driving gear. [6]

P.T.O.

b) An epicyclic gear train is shown in fig 2b. The arm 'a' rotates at 200 r.p.m. The gear 'P' with 20 teeth and gear 'B' with 40 teeth are compounded and rotate freely on the pin carried on the arm. The gear 'C' (30 teeth) is attached to the shaft. Find the speed of the shaft carrying gear 'C' and its relative direction to the arm. [10]

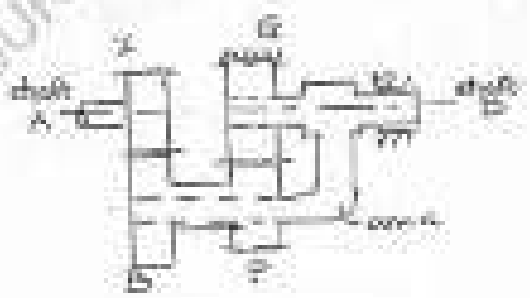

Fig. 2b.

Q3) a) Explain with sketch the following as related to gyroscope. [6]

i) Axis of Spin

ii) Axis of Precession,

iii) Active couple and

iv) Reactive couple

b) The turbine rotor of a ship has mass moment of inertia of 324 kg m^2. It rotates at 1800 rpm when looking from stern. [10]

i) Determine the gyroscopic couple and its direction when the ship is traveling at 40 km/hr and steers to the left in a curve of 100 m radius.

ii) If a maximum gyroscopic couple of 3000 Nm is permitted, what is the limiting speed of the rotor? Assume the speed of ship is proportional to rotor speed.

Q4) a) With neat sketch, explain various dynamic forces acting in reciprocating engine mechanism. [8]

OR

Explain Trifilar suspension system for determining M.I. of rigid body [8]

b) The following data relate to a horizontal reciprocating engine:

Mass of reciprocating parts = 120 kg, Crank Length = 90 mm, Engine speed = 600, Mass of connecting rod = 90 kg, Length between centers of connecting rod = 450 mm, Distance of center of mass from big end center = 160 mm, Radius of gyration about axis through center of mass =150 mm.

Find the magnitude and direction of the inertia torque on the crank shaft when the crank has turned through 30° from the inner dead center. [10]

Q5) a) Explain partial balancing of reciprocating masses in slider crank mechanism. [6]

OR

Explain primary crank and secondary crank in balancing of inline cylinder engine. [6]

b) The cranks and connecting rods of a 4 – cylinder in-line engine running at 1800 rpm are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 15 kg. Determine. [12]

i) Unbalanced primary and secondary forces if any.

ii) Unbalanced primary and secondary couples if any.

Q6) a) Explain Turning Moment Diagram used in analysis of flywheel. Also draw Turning Moment Diagram for steam engine, 4-stroke engine and multi cylinder engine. [6]

b) The radius of gyration of a flywheel is 1 meter and the fluctuation of speed is not to exceed 1% of the mean speed of the flywheel. If the mass of flywheel is 3340 kg and the steam engine develops 150 Kw at 135 rpm, then find: [10]

i) Maximum fluctuation of energy

ii) Co-efficient of fluctuation of energy.

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Total No. of Pages : 3

Seat No.	

T.E. (Mech.) (Part-III) (Semester-V)
Examination, November- 2019
HEAT AND MASS TRANSFER
Sub. Code :66243

Day and Date :Wednesday, 27- 11 - 2019 **Total Marks : 100**

Time : 2.30 p.m. to 5.30 p.m.

Instructions:
1) **All questions are compulsory.**
2) **Figure to the right indicate full marks.**
3) **Assume suitable data whenever necessary and state it clearly.**
4) **Use of specific calculators is permitted.**

Q1) Solve any three

a) Write Differential equation of conduction in Cartesian co-ordinate system. Also give the Laplace equation, poisons equation. [6]

b) Define critical radius of insulation. Also derive the equation for critical radius of insulation for hollow cylinder. [6]

c) A wall of house consists of three layers, an outward brick work 15cm thick an inner wooden panel 1.2cm thick, the intermediate layer is made up of an insulated layer 7cm thick. The thermal conductivities of brick, wood and insulating material are 0.7 W/m-K, 0.18 W/m-K and 0.1613 W/m-K respectively. The inside and outside temperatures of wall are 21 °C and and 15°C respectively. Calculate the rate of heat loss per unit area of the wall. [6]

d) A long rod of radius 50 cm with thermal conductivity of 10W/m-k contains radioactive material, which generates heat within the cylinder at a rate of 0.3×10^{5} W/m^3. The rod is cooled by convection from cylindrical surface having fluid temperature 50 °C and heat transfer coefficient 60 W/m^{2}K. Determine the temperature at the centre and at the outer surface of the cylindrical rod. [6]

P.T.O.

Q2) Solve any two:

a) Explain Lumped heat capacity analysis. Also give the physical significance of Fourier's number and Biot number. [8]

b) A stainless steel fin (K=20W/m-K) having diameter of 20 mm and length of 0.1m is attached to a wall at 300 °C, the ambient temperature is 50°C and the heat transfer coefficient is 10 W/m²K. The fin tip is insulated. Determine: [8]

1) Rate of heat dissipation from the fin
2) Temperature at the fin tip
3) The rate of heat transfer from the wall area covered by the fin if the fin was not used.

c) A cylindrical stainless steel ingot(K=45W/m-K), 15cm diameter passes through heat treatment furnace which is 6m in length. The temperature of furnace gas is 1300 °C. The initial ingot temperature is 100 °C. The heat transfer coefficient is 100W/m²K. Calculate the time required for ingot to attain a temperature of 850 °C. Also calculate velocity of ingot through the furnace [8]

Q3) Solve any two:

a) State planks law and Wien's law of radiation. Hence derive Wien's law from planks law [8]

b) Define radiation shape factor. Also derive expression for radiation shape factor for cylindrical cavity having diameter D and depth L with respect to itself. [8]

c) Calculate the following quantities for an industrial furnace assuming it as a black body emitting radiations at 2650 °C [8]

1) Monochromatic emissive power at Lambda= 1.2μm
2) The wavelength at which emissive power is maximum.
3) Maximum monochromatic emissive power.
4) Total emissive power.

Q4) Solve any two:

a) Derive an expression for effectiveness of counter flow heat exchanger in terms of NTU. [8]

b) What are the different dimensionless numbers in convection? Give physical significance of each. [8]

c) A counter- flow shell and tube type heat exchanger is to be used to cool water from 22°C to 6°C using brine entering at -2°C and leaving at 3°C. The overall heat transfer coefficient is estimated to be 500 W/m²°C. Calculate the heat transfer surface area for a design heat load of 10 kW. [8]

Q5) Solve any two,

a) Discuss the regimes of pool boiling with the help of pool boiling curve [8]

b) Define Grashoff's number and Reynolds number in natural and forced convection and explain the significance. [8]

c) With the help of dimensional analysis prove that Nusselt number is function of Grashoff's number and prandlt number. [8]

Q6) Write short notes (Any three) [18]

a) Fouling factor in case of heat exchangers

b) Dropwise and filmwise condensation

c) Design considerations for heat exchangers.

d) Forced convection boiling.

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Seat No.

Total No. of Pages : 4

T.E. (Mechanical) (Part - III) (Semester - V) (Revised)

Examination, November - 2019

MACHINE DESIGN - I

Sub. Code : 66244

Day and Date : Friday, 29 - 11 - 2019 Total Marks : 100

Time : 2.30 p.m. to 5.30 p.m.

Instructions:
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Make suitable assumption wherever required and state them clearly.
4) Use of non-programmable calculator is permitted.
5) Draw neat diagrams wherever necessary.

Q1) Solve any Three. [18]

a) Summarize the guidelines for the selection of quantitative values of 'factor of safety'.

b) Suggest with justification the suitable material for the following:
i) Boiler shell ii) Valve spring iii) Cutting tools

c) Explain design procedure of Knuckle joint with neat sketch.

d) Create a table showing different types of stresses in bolt design along with sketches.

Q2) a) A right angled bell-crank lever is to be designed to raise a load of 5 kN at the short arm end. The lengths of short and long arms are 100 and 450 mm respectively. The lever and the pins are made of steel 30C8 (S_{yt} = 400 N/mm^2) and the factor of safety is 5. The permissible bearing pressure on the pin is 10N/mm^2. The lever has rectangular cross section and the ratio of width to thickness is 3:1. The length to diameter ratio of fulcrum pin is 1.25:1. Calculate: [8]

i) The diameter and the length of fulcrum pin;

ii) The shear stress in the pin;

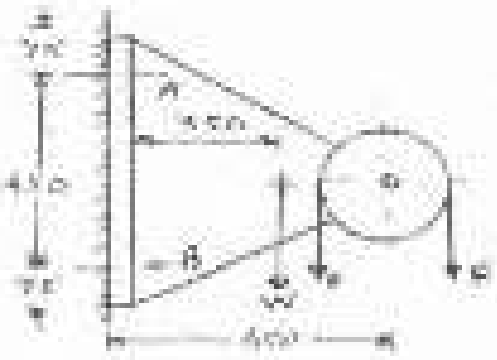
iii) The dimensions of boss of the lever at the fulcrum; and

iv) The dimensions of cross section of the lever.

Assume that the arm of bending moment on the lever extends up to the axis of fulcrum.

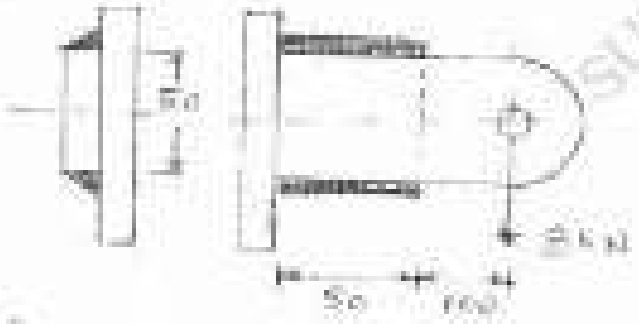
P.T.O.

b) Figure 2.b shows a pulley bracket, which is supported by 4 bolts, two at A and two at B location. The weight of pulley and bracket W is 2kN and the load F on the rope is 20 kN. Determine the size of the bolts, using an allowable shear stress of 40 MPa for the bolt material. [8]



OR

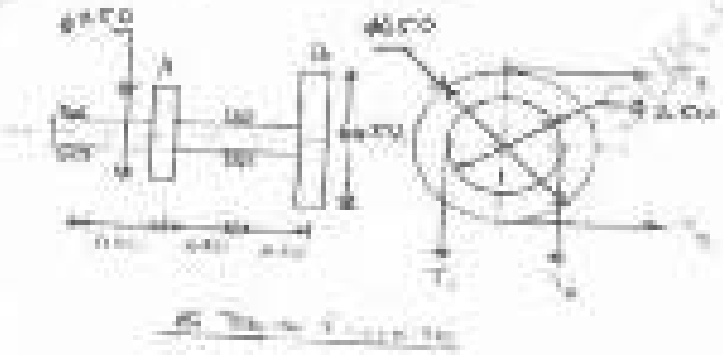
b) A welded connection as shown in figure 2c is subjected to the eccentric force of 8 kN in the plane of the welds. Determine the size of welds if the permissible shear stress for the weld is 90 N/mm². Assume static conditions. [8]



Q3) a) What types of stresses are induced in shafts? How the shaft is designed based on rigidity? [8]

b) Fig3b shows a line shaft supporting two pulleys A and B. Power is supplied to the shaft by means of vertical belt on pulley A, which is transmitted to pulley B carrying horizontal belt. The ratio of belt tension

on the tight and loose side is 3:1. Assume maximum Allowable tension in belt as 2.7 kN. The shaft is made of plain carbon steel 40C8 (S_{ut} = 650 N/mm² and S_{yt} = 380 N/mm²). Determine the size of the shaft according to ASME code if K_b = 1.5 and K_t = 1.0 [10]



OR

b) Design a rigid type of flange coupling to connect two shafts. The input shaft transmits 7 kW power at 800r.p.m. to the output shaft through a coupling. Assume that design torque is 1.5 times the rated torque. Given: material for shaft = 40C8 (Syt=380 N/mm², factor of safety=2.5), material for key=30C8 (Syt=400 N/mm², factor of safety = 2.5), material for flange FG 200 (Sut=200 N/mm², factor of safety=6 based on ultimate strength)

Q4) a) Derive an expression for deflection of helical spring of circular wire. [6]

b) Safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm². It is held on its seat by closed coil helical spring. The maximum lift of valve is 10 mm. Design a suitable compression spring of spring index 5 and providing an initial compression of 35 mm. The maximum shear stress in the material of wire is limited to 500 N/mm². The modulus of rigidity for spring material is 80 kN/mm². Assume squared and ground ends. Draw sketch of the spring Calculate: [10]

i) Diameter of the spring wire ii) Mean coil diameter

iii) Number of active turns and iv) Pitch of the coil

Assume Whal's Stress factor $K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$

Standard wire gauge (SWG) number and corresponding diameter of spring wire is given in the following table.

SWG	40	50	60	70
Diameter (mm)	10.160	10.975	11.785	12.70

Q5) a) What do you understand by overhauling and self locking of power screw? Hence deduce the condition for self locking screw. [8]

OR

a) What is recirculating ball screw? Explain with neat sketch. [6]

b) A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 kN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12 rpm. Assuming uniform wear condition at the collar and allowable thread bearing pressure of 5.8 N/mm², Find [12]

i) The torque required to rotate the screw.

ii) Stress in the screw.

iii) Number of threads of nut in engagement with screw.

Q6) a) Explain the step by step procedure for selection of V-belt from Manufacturer's Catalogue. [8]

b) It is required to select flat belt drive for a fan running at 360 rpm which is driven by a 10 kW 1440 rpm motor. The belt drive is open type and space is available for a center distance of 2 m approximately. The belt should operate at velocity between 17.80 m/s to 22.90 m/s. The power transmitting capacity of the belt per mm width per ply at 180° arc of contact and at a belt velocity of 5.08 m/s is 0.0118 kW. The load correction factor can be taken as 1.2. Suggest preferred pulley diameters for the motor and fan pulleys and give complete specifications of belting. Refer the tables given below. [10]

Data for Flat Belt Q. No. 6 b

Arc of Contact Factor (F_a)

α_2 (Deg)	130	140	150	160	170	180	190	200
F_a	1.26	1.19	1.13	1.08	1.04	1.00	0.97	0.94

Standard Widths of these belts in mm

1 - Ply	35	40	50	63	76					
4 - Ply	40	44	50	63	76	90	100	112	125	152
5 - Ply	75	100	112	125	152					
6 - Ply	112	125	152	180	200					

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Total No. of Pages : 3

Seat No.	

T.E. (Mechanical) (Part - III) (Semester - V) (Revised) Examination, December - 2019

MANUFACTURING ENGINEERING

Sub. Code : 66245

Day and Date : Monday, 2 - 12 - 2019 Total Marks : 100

Time : 2.30 p.m. to 6.30 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume suitable data wherever necessary and state it clearly.
4) Use of non-programmable calculator is allowed.

Q1) Solve any Two

a) Explain different types of chips with neat labeled diagram. [8]

b) Explain different types of tool material and list important properties of tool material. [8]

c) In an orthogonal cutting operation, the following data has been observed:

Width of cut	= 2.5 mm
Uncut chip thickness	= 0.25 mm
Chip thickness	= 0.75 mm
Cutting force	= 950 N
Thrust force	= 475 N
Rake angle	= 0°

Determine: Chip thickness ratio, shear angle, shear force and normal force on shear plane, friction force and normal force on the chip and coefficient of friction. [8]

Q2) Solve any Two

a) Explain the types and causes of tool wear with neat sketch. [8]

b) Draw tool geometry of drill and explain nomenclature in detail. [8]

c) While machining C40 steel with HSS tool at a feed rate of 0.75 mm/rev and 2 mm depth of cut, following observations were noted. Assuming Taylors equation as VT^n = Constant, recommend the cutting speed for desired tool life of 50 minutes.

Cutting speed (m/min)	40	60
Tool life (min)	70	25

[8]

P.T.O.

Q3) The component shown in Fig. 1 is to be processed on a single spindle automat. [18]
Study the component and prepare:

a) Detailed process sheet

b) Tool layout

c) Cam profile for drilling operation

Material: M.S. ϕ30 mm polish bar

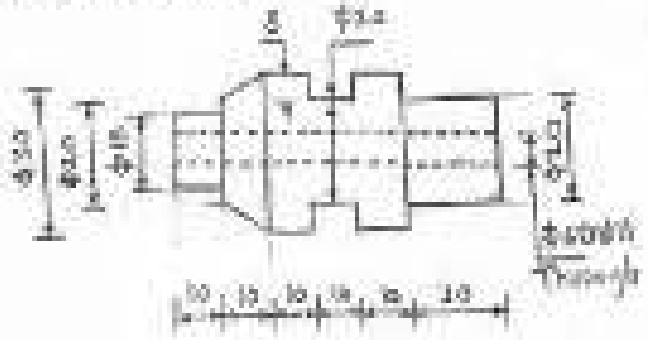

Fig.1

Q4) Solve any One

a) Design and draw a neat dimensional drawing in three views with one sectional view of a suitable drilling jig for drilling two holes of ϕ10mm as shown in Fig. 2. Show clearly the details of location, clamping and guiding of tool. Assume this as a final operation. [26]

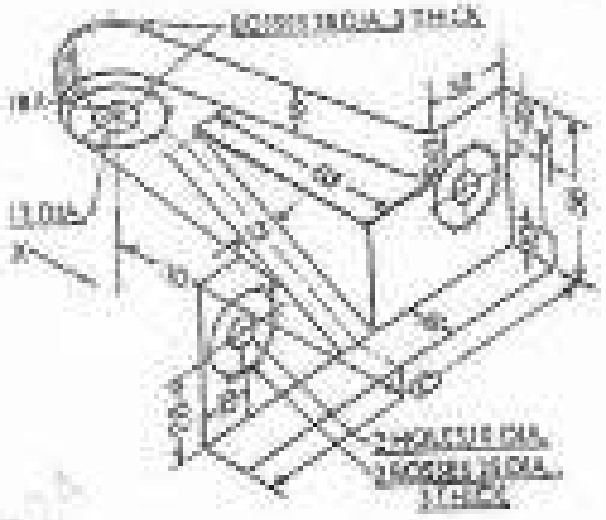

Fig.2

OR

h) Design and draw a dimensional drawing in three views with one sectional view of a milling fixture, for producing the 36 mm slot at the component shown in Fig. 3. Show clearly the details of location, clamping and setting of cutter. Assume this as a final operation. [26]

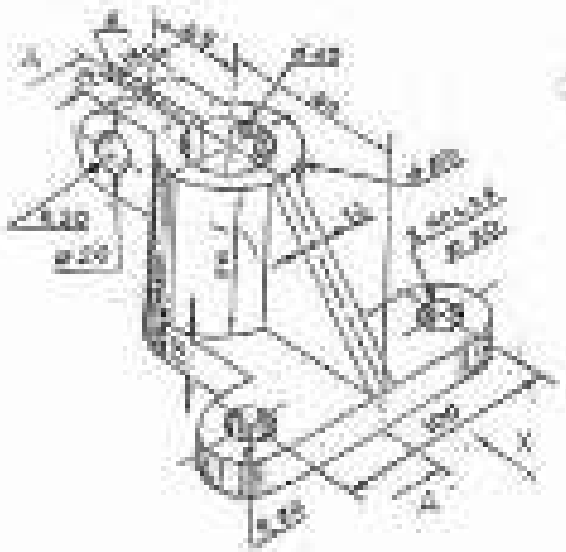

Fig. 3

Q5) Solve any two -

a) Explain different methods of reducing cutting forces in press working. [6]

b) Explain center of pressure in press working. [6]

c) A washer of 12.5 mm internal hole and an outside diameter of 25mm is to be made from 2 mm thick strip of 0.2 percent carbon steel. Considering the elastic recovery of the material, find: [6]

i) The blanking die opening size and the blanking punch size.

ii) The piercing punch size and the piercing die opening size. (Assume clearance is 5% of strip thickness)

Q6) Write short notes on any Three [12]

a) CNC axes and drives

b) Automatic pallet changer

c) Tool presetting

d) Modular tooling system for turning

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Seat No.

Total No. of Pages : 3

T.E. (Mech) (Semester - V) Examination, November - 2018

CONTROL ENGINEERING

Sub. Code : 66241

Day and Date : Monday, 19- 11 - 2018 Total Marks : 100

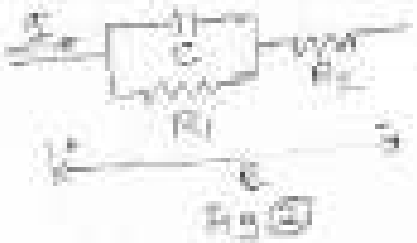
Time : 10.00 a.m. to 01.00 p.m.

Instructions: 1) All questions are compulsory.
2) Assume suitable data if required and mention it clearly.

Q1) a) A mechanical system is shown below. Determine the equation which relates x and f. [8]

b) For electrical system shown in fig. 2 construct an equivalent mechanical system using [8]

i) Direct analog ii) Inverse analog

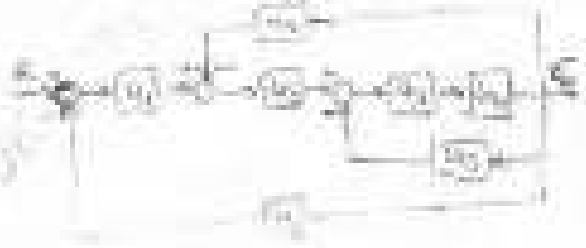


c) Explain mathematical model of gear train. [8]

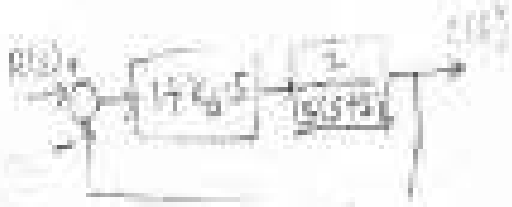
Q2) a) For operating curves shown. Determine Jones approximation for torque 't' [8]

P.T.O.

b) Reduce the block diagram shown in fig. and obtain transfer function. [8]



Q5) a) For unity feedback control system shown in fig. calculate value of K_a so that system is critically damped. Also calculate maximum overshoot and settling time. [8]



b) Determine the response c(t) for r(t) = a, u(t), d(t) = 0 and all initial conditions are zero. [8]

Q6) a) Sketch root locus plot for $G(s)H(s)=\dfrac{K}{s(s^2+5s+12)}$ [10]

b) A unity feedback control system is having an open loop transfer function $G(s)=\dfrac{K(s+12)}{s(s+3)(s+7)}$. Determine range of values of K for the system to be stable. [6]

Q5) a) Draw the bode plot for unity feedback control system with. [12]

$G(s)=\frac{10(s+10)}{s(s+3)(s+5)}$. From the plot determine values of gain margin and phase margin.

b) Obtain y(t) when x(t) is a unit step for the system. [6]

Q6) a) Determine state space representation and computer diagram using parallel programming. [8]

$$y(t)=\frac{1}{(D+2)(D+3)}f(t)$$

b) Determine state space representation and computer diagram using series programming. [8]

$$y(t)=\frac{D+3}{(D+1)(D+2)}f(t)$$

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Total No. of Pages : 3

Seat No.

T.E. (Mechanical Engineering) (Semester - V) Examination, November - 2018

THEORY OF MACHINES - II (Revised)

Sub. Code : 66242

Day and Date : Thursday, 22 - 11 - 2018 Total Marks : 100

Time : 10.00 a.m. to 01.30 p.m.

Instructions :
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat labelled sketch wherever necessary.
4) Assume if necessary suitable data and state clearly.
5) Use of Non-programmable calculator is permitted.

Q1) a) Derive the expression for the length of path of contact with usual notations. [8]

OR

Derive an expression for minimum number of teeth required on wheel to avoid interference in mesh with gear.

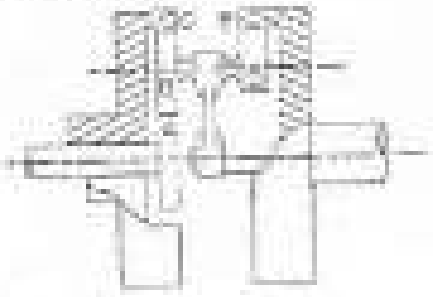
b) A pair of gears having 40 and 20 teeth respectively, are rotating in mesh, the speed of the smaller being 2000 rpm. Determine the angle through which the pinion turns while any pair of teeth are in contact. Assume the gear teeth are 20° involute form, addendum length is 5 mm and the module is 5 mm. [10]

Q2) a) How the velocity ratio of epicyclic gear train is obtained by tabular method. [6]

OR

Motor 'A' exerts a constant torque and is geared to shaft 'B'. The speed of shaft 'B' is G times the speed of motor. Show that the angular acceleration of the shaft 'B' is maximum when $G = \sqrt{\left[\frac{I_a}{I_b}\right]}$, where, I_a and I_b are the total mass moments of inertia of revolving parts attached to the respective shafts.

b) An epicyclic gear train, as shown in Fig. the driving wheel 'A' has 14 teeth and the fixed annular wheel 'C' 100 teeth, the ratio of teeth numbers to wheels 'E' and 'D' is 98 : 41. If speed is 1200 rpm of wheel 'A', find the speed and direction of 'E'. [10]



Fig

Q3) a) Write a note on gyroscope. [6]

b) A rear engine automobile is travelling along a track of 100 m mean radius. Each of 4 road wheels have moment of inertia 2 kg-m^2 and effective diameter 60 cm. The rotating parts of engine have moment of inertia of 1 kg-m^2. The engine axis is parallel to rear axle and crank shaft moves in the same sense as the road wheels. The gear train between engine to back axle is 3 : 1. The vehicle weighs 1500 kg and has C.G 30 cm above road level. The width of track of vehicle is 1.5 m. Determine the limiting speed of vehicle around the curve for all four wheels to maintain contact with the road surface if this is not combered. [14]

Q4) a) Derive an expression for correction couple to be applied to make two mass system dynamically equivalent. [6]

OR

Derive an expression for velocity and acceleration of the slider of slider crank mechanism.

b) A connecting rod of an IC engine has a mass of 2 kg and the distance between the centre of gudgeon pin and centre of crank pin is 250 mm. The C.G. falls at a point 150 mm from the gudgeon pin along the line of centres. The radius of gyration about an axis through the C.G. perpendicular to the plane of rotation is 110 mm. Find the equivalent dynamical system if only one of the masses is located at a gudgeon pin.

If the connecting rod is replaced by two masses, one at the gudgeon pin and the other at the crank pin and the angular acceleration of the rod is 23000 rad/s^2 clockwise, determine the correction couple applied to the system to reduce it to a dynamically equivalent system. [10]

Q5) a) Explain direct and reverse crank method for balancing of the radial engine. [8]

OR

Explain different cases of balancing of rotating masses.

b) A radial aero-engine has seven cylinders equally spaced with all the connecting rods coupled to a common crank. The crank and each of the connecting rods are 200 mm and 800 mm respectively. The reciprocating mass per cylinder is 3 kg. Determine the magnitude and the angular position of the balance masses required at the crank radius for complete primary and secondary balancing of the engine. [12]

Q6) a) Explain maximum fluctuation of energy and coefficient of fluctuation of energy. [8]

b) A multi-cylinder engine is to run at a speed of 900 rpm. On drawing the turning moment diagram to a scale of 1 mm = 3°, and 1 mm = 250 N-m, the areas above and below the mean torque line in mm^2 are: + 160, -172, + 168, -191, + 197, -162. The speed is to be kept within ± 1% of the mean speed of the engine. Calculate the necessary moment of inertia of the flywheel. Determine the suitable dimensions of a rectangular flywheel rim if the breadth is twice its thickness. The density of the cast iron is 7250 kg/m^3 and its hoop stress is 6 MPa. Assume that the rim contributes 92% of the flywheel effects. [10]

▽▽▽▽

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Total No. of Pages : 2

Seat No.

T.E. (Mechanical) (Part - III) (Semester - V) Examination, November - 2018

MACHINE DESIGN - I (Revised)

Sub. Code : 66244

Day and Date : Wednesday, 28 - 11 - 2018 Total Marks : 100

Time : 10.30 a.m. to 01.00 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Make suitable assumptions wherever required and state them clearly.
4) Use of non-programmable calculator is permitted.
5) Draw neat diagrams wherever necessary.

Q1) Solve any Three : [18]

a) Summarize procedure to design a machine element.

b) Suggest with justification the suitable material for the following :
   i) Pressure Cooker
   ii) Boiler Shell
   iii) Cutting tool

c) State the assumptions in design of a knuckle joint and explain in detail design of pin with the help of neat sketch.

d) Sketch V butt joint (any two types). Discuss design of butt weld joint under tension.

Q2) a) A turn-buckle is used to tighten a rope. Single start square threads are to be used and subjected to a maximum rope tension of 15 kN. The permissible tensile stress for the steel rods used is 70 MPa. The permissible tensile and shear stress for the cast iron nut used is 30 MPa. Design the turn-buckle. [8]

b) Figure 2b shows a cast iron bracket fixed to the steel structure. It supports load P of 25 kN. There are two bolts at A and two bolts at B. The distances are as follows l_1 =45mm, l_2 =180mm, l =300mm. Determine the size of the bolts, if maximum permissible tensile stress in the bolt is 50N/mm^2. Refer Table 1. [8]

P.T.O.

Fig 4a

OR

c) Figure 2c shows a plate bracket welded to a steel column, and loaded eccentrically. Determine the size of weld, assuming the maximum shear stress induced in the weld 150 N/mm^2.

Given: F=15kN, b=150mm

Fig 4c

Q.5) a) What are different types of stresses induced in shafts? How the shaft is designed based on rigidity? [6]

b) Fig 5b shows a line shaft supporting two pulleys A and B. Power is supplied to the shaft by means of a vertical belt on pulley A, which is transmitted to pulley B carrying horizontal belt. The ratio of belt tension on the tight and loose side is 3:1. Assume maximum allowable tension in the belts 2.7 kN. The shaft is made of plain carbon steel 40C8 (S_{ut}=650N/mm^2 and S_{yt}=380 N/mm^2). Determine the size of the shaft according to ASME code if k_b = 1.5 and k_t= 1.0. [10]

Fig 5b

OR

Design a rigid type of flange coupling to connect two shafts. The input shaft transmits 7 kW power at 800 r.p.m. to the output shaft through a coupling. Assume that design torque is 1.5 times the rated torque.

Given : material for shaft = 40C8 (S_{ut} = 380N/mm², factor of safety = 2.5), material for key=30C8 (S_{ut}=400N/mm²; factor of safety = 2.5); material for flange FC 200(S_{ut} = 200N/mm² factor of safety = 6 based on ultimate strength).

Designation	Pitch (mm)	Major or Nominal diameter (mm)	Minor or Core diameter (mm)	Tensile stress area (mm²)
M20	2.50	20	16.930	245
M24	3.00	24	20.319	353
M30	3.50	30	25.706	561
M36	4.00	36	31.093	817
M42	4.50	42	36.479	1120
M48	5.00	48	41.866	1470

Table 1

Q9 a) Derive an expression for deflection of helical spring of circular wire. [6]

b) Safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm². It is held on its seat by closed coil helical spring. The maximum lift of valve is 10 mm. Design a suitable compression spring of spring index 8 and providing an initial compression of 35 mm. The maximum shear stress in the material of wire is limited to 500 N/mm². The modulus of rigidity for spring material is 80 kN/mm². Assume squared and ground ends. Calculate : [10]

i) Diameter of the spring wire

ii) Mean coil diameter

iii) Number of active turns and

iv) Pitch of the coil

Assume Wahl's Stress factor $K=\frac{4C-1}{4C-4}+\frac{0.615}{C}$

Standard wire gauge (SWG) number and corresponding diameter of spring wire is given in the following table.

SWG	4/0	5/0	6/0	7/0
Diameter (mm)	10.160	10.973	11.785	12.70

Q5) a) What do you understand by overhauling and self locking of power screw? Hence deduce the condition for self locking screw. [6]

OR

What is recirculating ball screw? Explain with neat sketch.

b) A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 kN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction might assumed as 0.2 and 0.15 respectively. The screw rotates at 12 rpm. Assuming uniform wear condition at the collar and allowable thread bearing pressure of 5.8 N/mm^2. Find : [10]

i) The torque required to rotate the screw.

ii) Stress in the screw

iii) Number of threads of nut in engagement with screw

Q6) a) Explain the step by step procedure for selection of Flat belt from Manufacturer's Catalogue. [6]

b) It is require to design a V-belt drive to connect a 20 kW, 1440 rpm. Motor to a compressor running at 480 rpm for 15 hours per day. The space is available for a center distance of approximately 1.2 m. Refer following data.

Determine : [12]

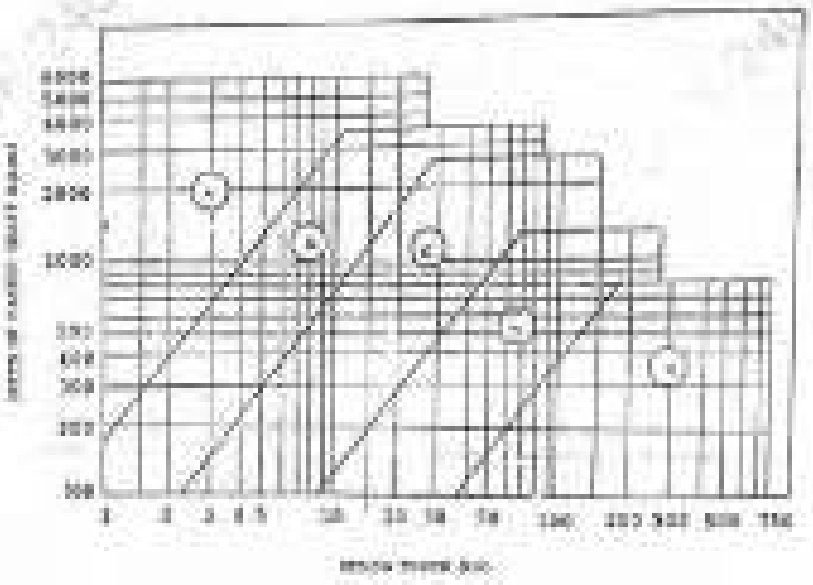
i) Diameter of motor and compressor pulley.

ii) Belt specifications

iii) Correct center distance

iv) Number of belts

Data for V Belt Q. No. 6 b



Power rating of V-belts

(θ_1 = 180°, speed of the faster pulley = 1440 r.p.m.)

(Pitch diameter (mm); PR = Power rating (kW))

Section	D	75	80	90	95	100	106	112	118	125
A	PR	0.73	0.88	0.89	1.13	1.18	1.30	1.63	1.81	2.08
Section	D	125	132	140	150	160	170	180	190	200
B	PR	2.08	2.42	2.71	3.20	3.60	4.00	4.38	4.77	5.23
Section	D	200	212	224	236	250	265	280	300	315
C	PR	4.14	4.81	5.40	6.08	8.43	10.10	11.80	12.10	12.20
Section	D	300	315	400	425					
D	PR	10.7	12.3	19.3	20.40					

Dimensions of standard cross-sections

Belt Section	Width W (mm)	Thickness T (mm)	Minimum pitch diameter of pulley (mm)
A	13	8	125
B	17	11	280
C	22	14	355
D	32	19	500
E	38	33	630

For 'V' belts

Series of preferred values for pitch diameters (in mm) are as follows:

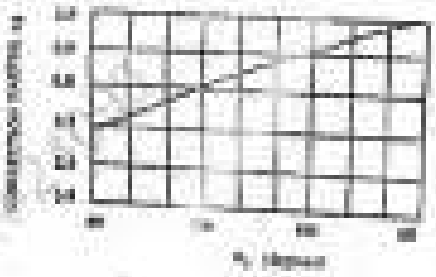
Pitch diameter (mm)	125	132	140	150	160	170	180	190
200	212	224	236	250	265	280	300	315	335	355
400	425	450	475	500	530	560	600	630	670	710
750	800	850	900							

Correction factor (F_2) for different services

Type of service	Operational hours per day		
	0-10	10-16	16-24
1) Light duty: agitators-blowers-centrifugal pumps-fans (up to 7.5 kW) and compressors	1.1	1.2	1.3
2) Medium duty: conveyors-lifts (above 7.5 kW)-line shafts-machine tools-printers and positive displacement pumps	1.2	1.3	1.4
3) Heavy duty: centrifugal-bucket elevators and hammers	1.3	1.4	1.5

Conversion of inside length to pitch length of the belt

Belt Section	A	B	C	D	E
Difference between pitch length and inside length (mm)	36	43	56	79	92



Correction factor for arc of contact (V-grooves on both pulleys)

Correction factor K_1 for belt length

H_p = Pitch height of the belt in mm)

L_p	Belt section				
	A	B	C	D	E
1900	1.02	0.87	0.87	–	–
1960	1.03	0.88	–	–	–
2032	1.04	–	–	–	–
2057	1.04	0.98	0.89	–	–
2159	1.05	0.99	0.90	–	–
2286	1.06	1.00	0.91	–	–
2438	1.08	–	0.93	–	–
2464	–	1.02	–	–	–
2540	–	1.03	–	–	–
2667	1.10	1.04	0.94	–	–
2845	1.12	1.06	0.96	–	–
3048	1.13	1.07	0.97	0.86	–
3226	–	–	0.98	–	–
3251	1.14	1.08	0.98	0.87	–
3404	–	–	0.99	–	–
3658	–	1.10	1.00	0.90	–
4064	–	1.12	1.02	0.92	–
4115	–	1.14	1.03	0.92	–
4394	–	1.15	1.04	0.93	–
4572	–	1.16	1.05	0.94	–
4801	–	1.18	1.07	0.95	–
5334	–	1.19	1.08	0.96	0.94
6045	–	–	1.11	1.00	0.96
6807	–	–	1.14	1.03	0.99
7605	–	–	1.16	1.05	1.01

Seat No.

T.E. (Mechanical) (Part - II) (Semester - V) (Revised) Examination, November - 2018

MANUFACTURING ENGINEERING

Sub. Code : 66245

Day and Date : Friday, 30 - 11 - 2018 Total Marks : 100

Time : 08.30 a.m. to 01.30 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume suitable data wherever necessary and state it clearly.
4) Use of non-programmable calculator is allowed.

Q1) Solve any Two

a) Explain different types of chips with neat labeled diagram. [8]

b) What is machinability? Explain various factors affecting machinability [8]

c) In an orthogonal cutting operation, the cutting force is 1350N, the feed thrust force is 670N, the rake angle 7°, feed is 0.18mm and chip thickness is 0.25mm. Calculate: Chip thickness ratio, shear angle, shear force and normal force at shear plane, friction force and normal force on tool face and coefficient of friction. [8]

Q2) Solve any Two

a) Explain the types and causes of tool wear with neat sketch. [8]

b) Draw tool geometry of milling cutter and explain nomenclature in detail [8]

c) The following equation for tool life has been obtained for HSS tool.

$$VT^{0.45} f^{0.6} d^{0.3} = C$$

A 60 min. tool life was obtained using the following cutting conditions:

$V = 60$ m/min, $f = 0.25$ mm, $d = 2.0$ mm

Calculate the effect on tool life if speed, feed and depth of cut are together increased by 25% and also if they are increased individually by 25 %. [8]

P.T.O.

Q3) The component shown in Fig. 1 is to be processed on a single spindle automat. Study the component and prepare:

a) Detailed process sheet

b) Tool layout

c) Cam profile for drilling operation (ϕ6 X 35mm deep) [18]

Material: M.S. polish bar ϕ30mm

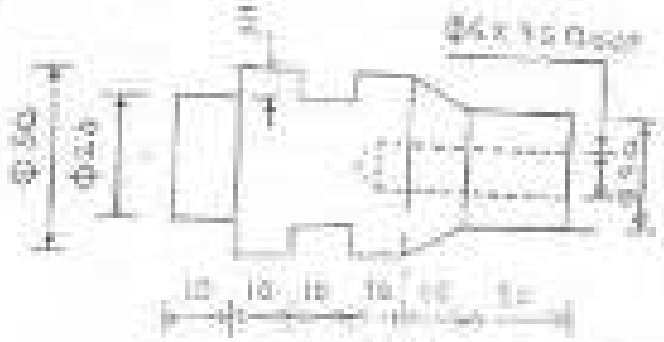


Fig.1

Q4) Solve any One

a) Design and draw a neat dimensional drawing in three views with one sectional view of a suitable drilling jig for drilling two holes of ϕ15 mm as shown in Fig. 2. Show also the details of location, clamping and guiding of tool. Assume this as a first operation. [26]

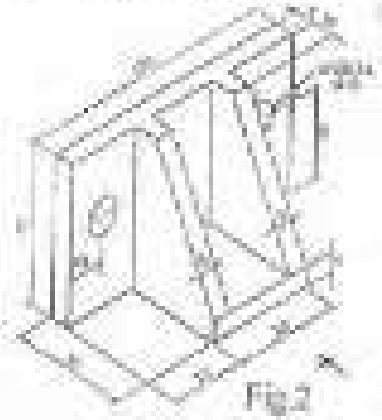


Fig.2

OR

b) Design and draw a dimensional drawing in three views with one sectional view of a milling fixture, for producing the 6 mm wide slot as the component shown in Fig. 3. Show clearly the details of location, clamping and setting of cutter. Assume this as a final operation. [26]

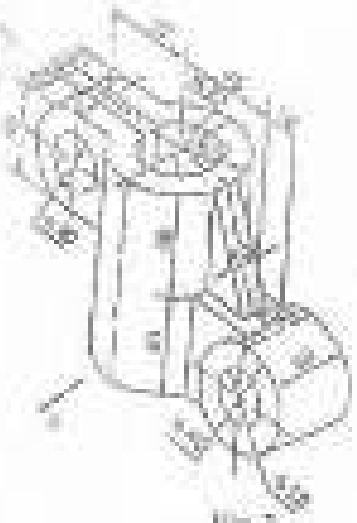


Fig 3

Q5) Solve any Two

a) Explain different methods of reducing cutting forces in press working. [6]

b) Explain center of pressure in press working. [6]

c) Estimate the blanking force to cut a blank 20mm wide and 30mm long from a 1.5mm thick metal strip, if the ultimate shear stress of material is 450N/mm². Also determine the work done if the percentage penetration is 25 percent of material thickness. [6]

Q6) Write short notes on any Three [12]

a) CNC axes and drives

b) Automatic pallet changer

c) Tool presetting

d) Modular tooling system for turning

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Total No. of Pages : 3

Seat No.	

T.E. (Mech) (Part - III) (Semester - V) Examination, November- 2018

HEAT AND MASS TRANSFER

Sub. Code : 66243

Day and Date : Monday, 26 - 11 - 2018 Total Marks : 100

Time : 10.00 a.m. to 01.00 p.m.

Instructions : 1) All questions are compulsory.

2) Figure to the right indicates full marks.

3) Assume suitable data whenever Necessary and State it clearly.

4) Use of specific calculators is permitted.

Q1) Solve any four.

a) Explain the different modes of heat transfer with suitable example and also give basic law for each one. [6]

b) Define critical radius of insulation. Also derive the equation for critical radius of insulation for hollow cylinder. [6]

c) An industrial freezer is designed to operate with an internal air temperature of -20°C, when the external air temperature is 25°C. The internal and external heat transfer coefficients are 12 W/m²K and 8W/m²K, respectively. The wall of the freezer consists of an inner layer of plastic (k=1 W/mK), 3mm thick and an outer layer of stainless steel (k=18W/mK), 1mm thick. A layer of insulation material (k=0.07W/mK) is sandwiched between these two layers. Find the thickness of insulation required to reduce the convective heat loss to 15W/m². [6]

d) A steam pipe is covered with two layers of insulation, first layer being 3cm thick and second 5cm. The pipe is made of steel (k=58W/mK) having ID of 160mm and OD of 170mm. The inside and outside film coefficients are 30 and 5 kW/m²K, respectively. Calculate the heat lost per metre of pipe, If the steam temperature is 300°C and air temperature is 50°C. The thermal conductivity of two insulating materials are 0.17 and 0.093 W/mK, respectively. [6]

P.T.O.

Q3) Solve any Two

a) Derive expression for temperature distribution of a solid cylinder generating heat at the rate of q unit per unit Volume. [8]

b) A solid steel ball 5cm in diameter and initially at 450°C is quenched in a controlled environment at 90°C with convection coefficient of 10 W/m²K. Determine the time taken by centre to reach a temperature of 150°C. Take thermo physical properties as density=8000kg/m³, C=420J/kgK, k= 46 W/mK [8]

c) The rate of heat generation in a slab of thickness 160mm (k=180W/m°C) is 1.2×10^6 W/m³. If the temperature of each of the surface of solid is 120°C, Determine: [8]

i) The temperature at the mid and quarter planes.

ii) The heat flow rate and temperature gradients at the mid and quarter plane.

Q4) Solve any Two

a) Explain the different types of fins with the help of neat sketch and list different boundary conditions of the fins. [8]

b) Derive the expression for temperature distribution in a fin of finite length with insulated end. [8]

c) Find out the amount of heat transferred through an iron fin of length 50mm, width 100mm and thickness 5mm. Assume k=110W/mK and h=42W/m²K for the material of fin and temperature at the base of the fin as 80°C. Also determine the temperature at tip of the fin, if the atmospheric temperature is 20°C. [8]

Q5) Solve any two of the following:

a) With the help of dimensional analysis prove that Nusselt number is a function of Grashoff's number and Prandtl number. [8]

b) Give the physical significance of. [8]

i) Reynolds Number ii) Grashoff's Number

iii) Nusselt Number iv) Prandtl Number

c) A Cylindrical body of 300 mm diameter and 1.6 m height is maintained at a constant temperature of 36.5°C. The surrounding air temperature is 15.5°C. Determine the amount of heat to be generated by the body per hour. Use the correlation $Nu = 0.126(Gr.Pr)^{1/3}$. Take $\rho = 1.025$ kg/m³, $\nu = 15.06\times10^{-6}$ m²/s, $C_p = 0.98$ kJ/kg K, k = 0.0692kJ/mhK and $\beta = 1/298$ K⁻¹. [8]

Q5) Solve any three of the following: [18]

a) Concept of Black Body

b) Emissivity and Transmissivity

c) Various theories of radiation heat transfer

d) Statement and proof of Kirchoff's law

Q6) Solve any two of the following: [18]

a) Define the following terms related to the heat exchanger:

i) Effectiveness ii) Fouling factor

iii) LMTD iv) NTU

b) Derive an expression for LMTD of counter flow heat exchanger.

c) Two fluids A and B exchange heat in a counter flow heat exchanger. Fluid A enters at 420°C and has a mass flow rate of 1 kg/s. Fluid B enters at 20°C and has a mass flow rate of 1 kg/s. Effectiveness of heat exchanger is 75 %. Specific heat of fluid A is 1.05kgK and that of fluid B is 4kJ/kgK.

Determine:

i) Heat transfer rate

ii) Exit temperature of fluid B

Seat No.	

T.E. (Mechanical Engineering) (Part - III) (Semester - V)
(Revised) Examination, November - 2017
THEORY OF MACHINES - II
Sub. Code: 66242

Day and Date :Saturday, 11 - 11 - 2017 Total Marks : 100
Time :10.00 a.m. to 1.00 p.m.

Instructions :
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat labeled sketch wherever necessary.
4) Assume if necessary suitable data and state clearly.
5) Use of Non programmable calculator is permitted.

Q1) a) Give the classification of Toothed Gearing and define the following terms.

i) Addendum.

ii) Module. [8]

OR

Derive the expression for the velocity of sliding between pair of involute teeth and define the terms.

i) Pitch Circle.

ii) Diametral Pitch.

b) A pair of Spur gears with involute teeth is to give a gear ratio of 4 : 1. The arc of approach is not to less than the circular pitch and smaller wheel is the driver. The angle of pressure is 14.5°. Find

i) the least number of teeth that can be used on each wheel and

ii) the addendum of the wheel in terms of the circular pitch. [10]

P.T.O.

Q2) a) What are the various types of the torques in an epicyclic gear train. [6]

OR

Explain the concept of equivalent mass and moment of inertia applied for gear trains.

b) Fig. 2 b shows an epicyclic gear train 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/s. 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 same module. When engine develops the 130 kW, what is the holding torque on the wheel 'D'? Assume 100 percent efficiency throughout. [10]

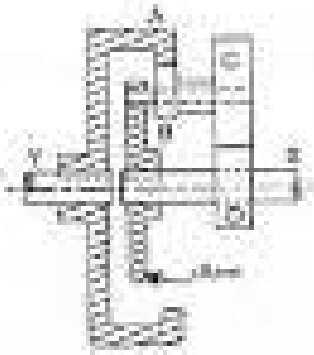

Fig. 2 b.

Q3) a) Condition for stability of two wheel vehicle moving in a curved path. [6]

b) A ship propelled by a turbine rotor which has a mass of 5 tonnes and a speed of 2100 rpm. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic couple in the following conditions.

i) The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius.

ii) The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.

iii) The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern. [10]

Q4) a) Derive the equation for inertia torque analytically considering the effect of inertia of the connecting rod. [6]

OR

Derive an expression for velocity and acceleration of the slider of slider crank mechanism.

b) In a vertical double acting steam engine, the connecting rod is 4.5 times the crank. The weight of the reciprocating parts is 120 kg and the stroke of the piston is 440 mm. The engine runs at 250 rpm. If the net load on the piston due to steam pressure is 25 KN when the crank has turned through an angle of 120° from the top dead centre, determine the

i) thrust in the connecting rod.

ii) pressure on the slide bars.

iii) tangential force on the crank pin.

iv) thrust on the bearings.

v) turning moment on the crank shaft. [10]

Q5) a) Explain balancing of single rotating mass by two masses rotating in different planes. [6]

OR

Explain direct and reverse crank method for balancing of radial engine.

b) The crank and the connecting rod of a 4 - cylinder in-line engine running at 1800 r.p.m. are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1 - 4 - 2 - 3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine:

i) Unbalanced primary and secondary forces, if any, and

ii) Unbalanced primary and secondary couples with reference to central plane of the engine. [12]

Q6) a) Derive expression for energy stored in a flywheel. [6]

b) A single cylinder double acting steam engine develops 150 kW at a mean speed of 80 rpm. The coefficient of fluctuation of energy is 0.1 and the fluctuation of speed is ± 2% of mean speed. If the mean diameter of the flywheel rim is 2 metre and the hub and spokes provide 5% of the rotational inertia of the flywheel, find the mass and cross-sectional area of the flywheel rim. Assume the density of the flywheel material as 7200 kg/m³. [10]

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Total No. of Pages : 3

Seat No.	

T.E. (Mechanical) (Part-III) (Semester-V) (Revised) Examination, November - 2017

HEAT AND MASS TRANSFER

Sub. Code : 66243

Day and Date : Tuesday, 14-11-2017 **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions :
1) All Questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume Suitable Data whenever necessary and state it Clearly.
4) Use of scientific non programmable calculator is permitted.

Q1) Solve any three:

a) Define critical radius of insulation. Also derive the equation for critical radius of insulation for hollow sphere. [6]

b) Explain the different modes of mass transfer. Explain with suitable examples. [6]

c) A 0.8m high and 1.5m wide double pane window consist of two 4mm thick layer of glass (k = 0.78 W/mK) separated by 10mm wide stagnant air space (k = 0.0626 W/mK). Determine the rate of heat transfer through this window when room is maintained at 20°C and outside air is at -10°C. Take convective heat transfer coefficient as 10 and 40 W/m²K. [6]

d) An aluminium pipe carries steam at 110°C. The pipe (k = 185 W/mK) has an inner diameter of 10cm and outer diameter of 12cm. The pipe is located in a room where the ambient air temperature is 30°C and convective heat transfer coefficient is 15 W/m²K. Determine heat transfer rate per unit length of pipe. Neglect convective heat transfer on steam side. [6]

Q2) Solve any two:

a) Derive expression for temperature distribution of a solid cylinder generating heat at the rate of q unit per unit volume. [8]

P.T.O.

b) Derive expression of temperature distribution for a solid body by using lumped heat capacity approach. [8]

c) A solid copper sphere of 10cm diameter (ρ = 8954 kg/m^3, C_p = 383 J/kgK, k = 386 W/mK). Initially at uniform temperature 250°C, it suddenly immersed in a fluid which is maintained at uniform temperature of 50°C. The heat transfer coefficient between sphere and fluid is 200 W/m^{2}K. Determine the temperature of copper sphere at 5 minutes after immersion. [8]

Q3) Solve any two:

a) Derive an expression for temperature distribution along the length of a pin fin with insulated tip. [8]

b) A 1m long, 5cm diameter cylinder placed in an atmosphere of 40°C is provided with 12 fins (k = 75 W/mK), 0.75mm thick. The fins protrudes 2.5cm from the cylinder surface. The heat transfer coefficient is 23.3 W/m^{2}K. Calculate the rate of heat transfer if the surface temperature of cylinder is 150°C. [8]

c) Determine thermal conductivity of long solid 2cm diameter rod, 1 end of the rod is inserted in a furnace while remaining portion is projected out in air at 30°C. After steady state has been reached, the temperature at two points on the rod which are 10cm apart are measured and found to be 120°C and 90°C respectively. If heat transfer coefficient is 20 W/m^{2}K. What will be thermal conductivity of the rod? [8]

Q4) Solve any two of the following:

a) With the help of dimensional analysis, analyze natural convection heat transfer problem. [8]

b) A vertical cylinder 1.5m high and 180mm in diameter is maintained at 100°C in an atmosphere environment of 20°C. Calculate heat loss by free convection from the surface of the cylinder. Assume properties of air at mean film temperature as, ρ= 1.06 kg/m^3, γ= 18.97×10^{-6}m^2/s, C_p=1.004 kJ/kg°C and k=0.0285 w/m°C, Pr = 0.708. [8]

Use correlation: $Nu_m = 0.10\,(Gr.Pr)^{1/3}$.

c) Air at a temperature of 20°C flows through a rectangular duct with a velocity of 10m/s. The duct is 30cm×20cm in size and air leaves at 34°C. Find the heat gain by air when it is passed through 10m long duct. The properties of air at 27°C are ρ=1.1774 kg/m³, ν= 15.68 10^{-6}m²/s, C_p=1057 J/kgK and k=0.03003 W/mK, Pr = 0.708. [8]
Use correlation ; Nu = 0.023 $(Re)^{0.8}$ $pr^{0.4}$.

Q5) Solve any two of the following:

a) Write a short notes on; [8]
   i) Shape factor and its properties
   ii) Radiation shield

b) Write plank's law and derive Stefan Boltzman law from Plank's law. [8]

c) The effective temperature of a body having an area of 0.12m² is 527°C. [8]
Calculate;
   i) The total rate of energy emission
   ii) The intensity of normal radiation
   iii) The wavelength of maximum monochromatic emissive power

Q6) a) Draw the temperature distribution curve for following heat exchangers (any 3) [6]
   i) Counter flow heat Exchanger
   ii) Evaporator
   iii) Parallel flow heat Exchanger
   iv) Condenser

b) What are the design considerations of heat exchangers? [6]

c) The flow rates of hot and cold water streams running through a parallel flow heat exchanger are 0.2kg/s and 0.5kg/s respectively. The inlet temperatures of hot and cold sides are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. If overall heat transfer coefficient is 325 W/m²°C, calculated the area of heat exchanger. Assume C_p of water 4.187 kJ/kgK. [6]

Seat No.	

T.E. (Mechanical) (Part - III) (Semester - V) (Revised) Examination, November - 2017
MACHINE DESIGN - I
Sub. Code: 66244

Day and Date :Monday, 20 - 11 - 2017 Total Marks : 100
Time :10.00 a.m. to 1.00 p.m.

Instructions:
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Make suitable assumption wherever required and state them clearly.
4) Use of non-programmable calculator is permitted.
5) Draw neat diagrams wherever necessary.

Q1) Solve any Three: [18]

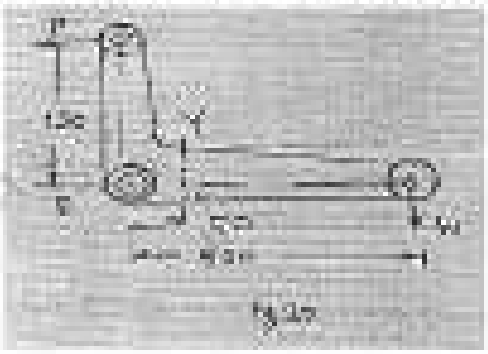
a) Summarize material selection procedure adopted for designing a machine element.

b) Name different theories of failure.Illustrate the use of theory of failure for brittle material.

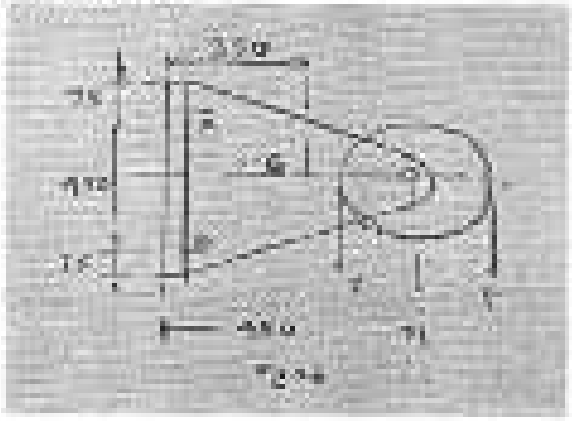
c) Explain the design procedure for a turn-buckle with the help of neat sketch.

d) Write a note on design of bolted joints with load perpendicular to the axis of bolt.

Q2) a) A bell crank lever to raise a vertical load is shown in fig 2a. The vertical load to be lifted is 4500N. The lever consists of forged steel material and a pin at the fulcrum F. Assume following data for the lever material. Safe stress in tension = 75 MPa; safe stress in shear=60MPa; safe bearing pressure on pins=10N/mm². Determine the pin diameter at end P, dimensions at F and cross section Y-Y (near to fulcrum) [8]

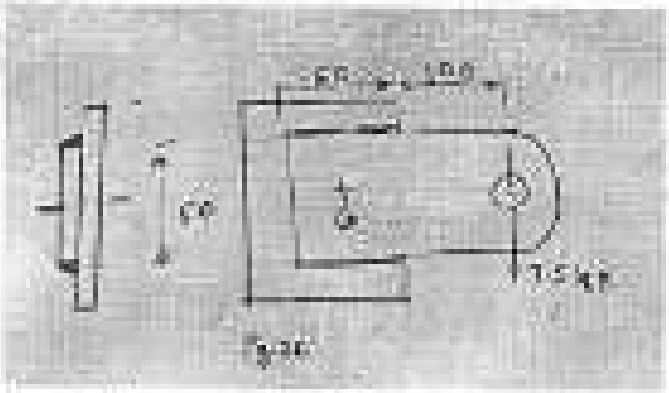


b) Figure 2b shows a pulley bracket, which is supported by 4 bolts, two at A and two at B. The weight of pulley and bracket, W is 1850N, and the load, F on the rope is 20kN.
Determine the size of the bolts, using an allowable shear stress of 40 MPa for the bolt material. [8]



OR

c) A welded connection as shown in figure 2c is subjected to the eccentric force of 7.5 kN. Determine the size of welds if the permissible shear stress for the weld is 90N/mm². Assume static conditions. [8]



Q3) a) Discuss the design procedure for square key. [6]

b) A splined connection with the following particulars is used for a gear and shaft assembly in a gear box. The power to be transmitted is 20kW at 240 r.p.m. The bearing pressure on the splines is limited to 6.5MPa during sliding. The coefficient of friction is 0.1 [10]
Major diameter = 60mm
Minor diameter = 54 mm
Number of splines = 10
Determine (i) The length of gear hub
ii) The force required to shift the gear.

OR

c) Design a cast iron protective type flange coupling to transmit 15 kW at 900 r.p.m. from an electric motor to a compressor. The service factor may be assumed as 1.35. The following permissible stresses may be used:
Shear stress for shaft, bolt and key material =40MPa
Crushing stress for bolt and key = 80 MPa
Shear stress for cast iron = 8 Mpa
Draw a neat sketch of the coupling. [10]

Q4) a) What are the various types of springs used in practice? Explain one application of each. [6]

b) Design a close coiled helical compression spring for a service load ranging from 2245N to 2745N. The axial deflection of the spring for this load range is 6mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity is 84kN/mm². Assume squared and ground ends for coil. Neglect the effect of stress concentration. Draw fully dimensioned sketch of the spring.
Std. wire gauge (SWG) number and corresponding diameter of spring wire is given in the following table. [10]

SWG	6/0	5/0	4/0	3/0	2/0
Diam mm	11.785	10.973	0.160	9.490	8.839

Q5) a) Derive an expression for maximum efficiency for square threaded screw. [6]

OR

What is recalculating ball screw? Explain with neat sketch.

b) The power transmission screw of a screw press is required to transmit maximum load of 100 kN and rotates at 60 RPM. The trapezoidal threads are to be used as under:

Nominal Dia. mm	40	50	60	70
Core Dia. mm	32.50	41.50	50.50	59.50
Mean Dia. mm	36.50	46.00	55.50	65.00
Core Area mm²	830	1353	2003	2781
Pitch mm	7	8	9	10

The screw thread friction coefficient is 0.12. The torque required for collar friction and journal bearing is about 10% of the torque to drive the load considering screw friction. Determine screw dimensions and its efficiency. Also determine the motor power required to drive the screw. The maximum permissible compressive stress in the screw is 100 MPa. [12]

Q6) a) Explain the step by step procedure for selection of V- belt from Manufacturer's Catalogue. [6]

b) It is required to select flat belt drive for a fan running at 360 rpm which is driven by a 10kW 1440 rpm motor. The belt drive is open type and space is available for a center distance of 2 m approximately. The belt should operate at velocity between 17.80 m/s to 22.90 m/s. The power transmitting capacity of the belt per mm width per ply at 180° arc of contact and at a belt velocity of 5.08 m/s is 0.0118 kW. The load correction factor can be taken as 1.2. Suggest preferred pulley diameters for the motor and fan pulleys and give complete specifications of belting. Refer the tables given below. [10]

Arc of Contact Factor (F_α)

α_1(Deg)	130	140	150	160	170	180	190	200
F_α	1.26	1.19	1.13	1.08	1.04	1.00	0.97	0.94

Standard Widths of these belts in mm

3-Ply	25	40	50	63	76					
4-Ply	40	44	50	63	76	90	100	112	125	152
5-Ply	76	100	112	125	152					
6-Ply	112	125	152	180	200					

For flat pulleys: Series of preferred values of pitch diameters (in mm) are as follows.

Pitch diameter (mm):									
200	212	224	236	250	265	280	300	315	355	375
400	425	450	475	500	530	560	600	630	670	710
750	800	900	1000							

Seat No.	

T.E. (Mechanical) (Part - III) (Semester - V) (Revised)
Examination, November - 2017
MANUFACTURING ENGINEERING
Sub. Code : 66245

Day and Date : Wednesday, 22 - 11 - 2017 **Total Marks : 100**
Time : 9.30 a.m. to 1.30 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume if necessary suitable data and state them clearly.
4) Use of non-programmable calculators is permissible.

SECTION - I

Q1) Solve any two:

a) Explain with neat sketch the types of milling cutters. [8]

b) Derive an expression for Shear strain. [8]

c) In an Orthogonal cutting of the material, Cutting force (F_c) = 138Kg. Feed force (F_t) = 68Kg. Rake angle (α) = 7°. Chip thickness ratio (r) = 0.4. Determine

i) Coefficient of friction of chip

ii) Shear force (Fs) and normal to shear force (Fn). [8]

Q2) Solve the following questions.

a) Define machinability. Explain the factors affecting machinability. How the machinability index is defined? [8]

OR

a) Explin concept of wear & types of wear with sketch. [8]

b) Determine [8]

P.T.O.

i) Taylor's Tool life equation

ii) Cutting speed for 6 minutes of tool life when tool life of 70 minutes is obtained at a speed of 25m/min and 15 minutes at 40m/min.

Q3) The component shown in fig. is to be processed on a single spindle automat. Study the component and prepare: [18]

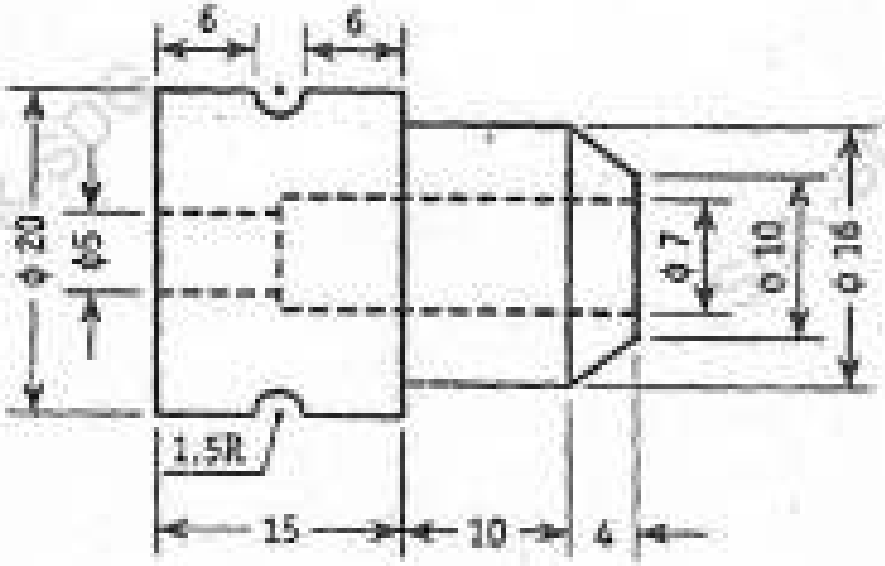
a) Detailed process sheet

b) Tool Layout

c) Cam profile for drilling operation of ø5 mm hole through

d) Calculate Production rate per hour

Material –ϕ 20 Bronze bar All dimensions are in mm.



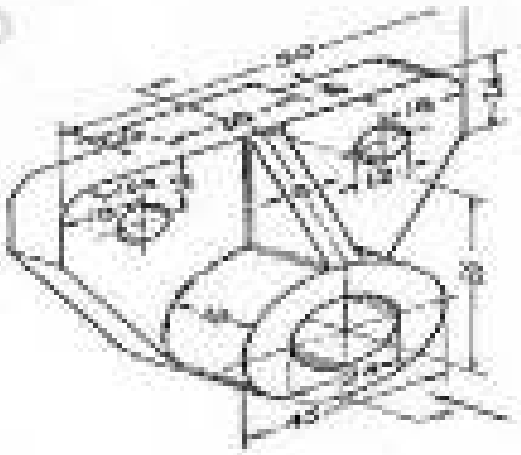
SECTION - II

Q4) Design & draw neat dimensional drawing in three views with one sectional view of jig for drilling two holes ϕ12 in the given bracket as shown in figure. [26]

OR

Design & draw neat dimensional drawing in three views with one sectional view of Milling fixture for creating plane surface of ϕ 24mm of the given bracket as shown in figure.

Also Justify the selection of location, clamping & guiding elements.



Q5) Attempt any two.

a) Explain with neat sketch the Compound die. [6]

b) Explain types of Stock stop. [6]

c) Explain the importance of following in Press working [6]

i) Strippers

ii) Clearance

Q6) Write short notes any three. [12]

a) Construction & working of CNC.

b) Automatic Tool Changer.

c) CNC axes and drives.

d) Modular Tooling System.

♠ ♠ ♠

Seat No.	

T.E. (Mechanical) (Semester - V) Examination, November - 2017

CONTROL ENGINEERING

Sub. Code : 66241

Day and Date : Thursday, 09 - 11 - 2017 **Total Marks : 100**

Time : 10.00 a.m. to 01.00 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to the right indicates full marks.
3) Assume any additional data if required and mention it clearly.

Q1) a) For the mechanical system shown in Fig. 1 a, prepare grounded chair representation and construct electrical circuit using force current analog. [6]

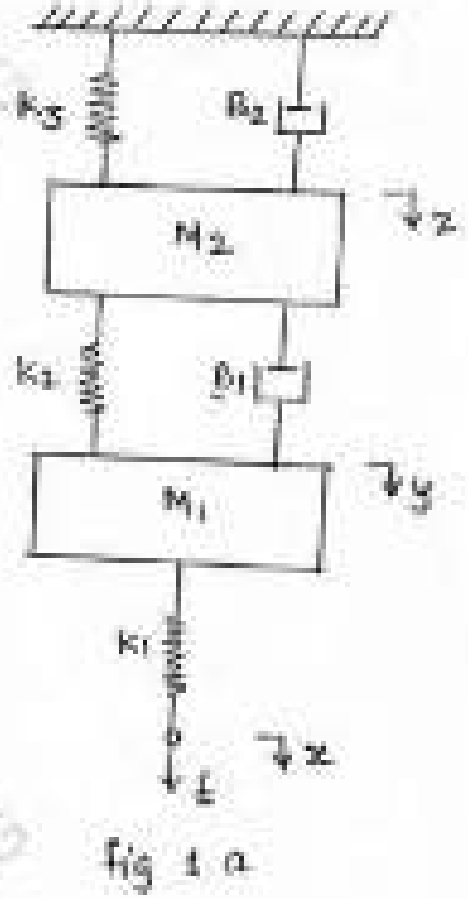


Fig 1 a

b) For the fluid system shown in Fig. 1b, determine equation of P1 in terms of P2 and P. [6]

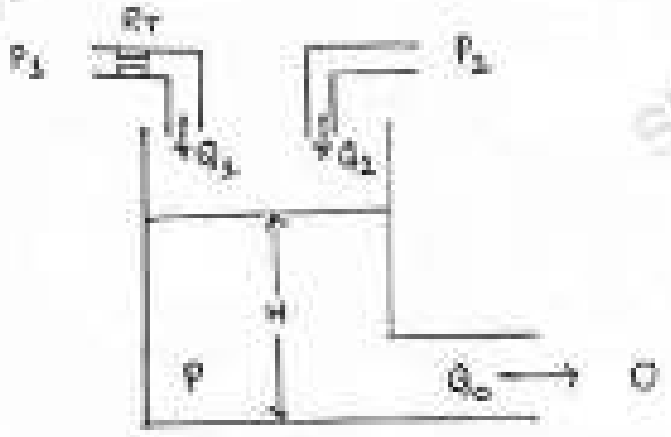


Fig 1 b

c) For the thermometer shown in fig. 1c, the ambient temperature is Ts and temperature of fluid is T. The rate of heat flow from surrounding medium to the fluid is $Q = C_1(Ts - T)$ The rate of change of temperature of fluid is $D\,T = C_2\,Q$ construct the block diagram representation for the system in which Ts is input and T is output. Determine time constant. [6]

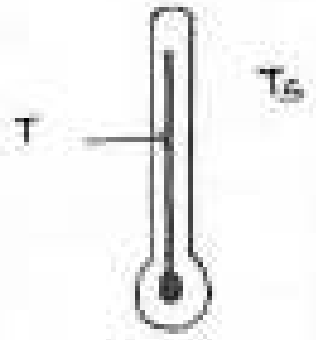


Fig 1 C

Q2) a) Determine linear approximation for the equation $Z = \sin X \cdot \cos Y$ for $Xi = 60°$ and $Yi = 30°$. What is approximate value of Z when $X = 63°$ and $Y = 28°$. [8]

b) Reduce the block diagram shown in fig. 2b and obtain transfer function. [8]

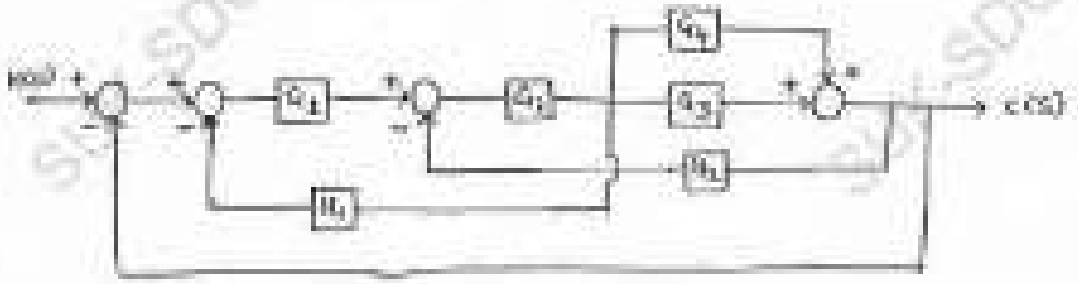


fig 2 b

Q.3) a) A hydraulic control system is shown in fig. 3a. The forcing function is r(t) = u(t) and all initial conditions are zero. Determine the response c(t) of system. [8]

fig 3 a

b) For the control system shown in fig. 3b, determine K_1, K_2 and a such that the system will have a steady state gain of 1, a natural frequency of 2 and damping ratio of 0.5 [8]

Fig 3 b

Q4) a) Sketch root locus plot for $G(S)\,H(S) = \dfrac{K}{S(S^2+6.8S+12)}$ [12]

b) A unity feedback control system is having an open loop transfer function $G(S) = \dfrac{K(S+13)}{S(S+3)(S+7)}$ Determine the range of values of K for the system to be stable. [6]

Q5) a) Sketch the Bode plot for the transfer function

$G(S) = \dfrac{1000}{S(1+0.1S)(1+0.001S)}$ Determine gain margin and phase margin. [10]

b) Calculate break in point and angle of departure for the control system, given by characteristic equation $S^2 + 2S + 3 + K(S + 2) = 0$. [6]

Q6) a) The motion of a numerically controlled machine tool is described by the differential equation $\ddot{y} + 7.\dot{y} + 10.y = f(t)$. Determine computer diagram and state space representation using parallel method. [8]

b) The motion of robot arm controlled by an electric motor is given by the differential equation $\ddot{y} + 6.\dot{y} + 9.y = f(t)$. Use series programming to determine computer diagram. [8]

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Seat No.

Total No. of Pages : 4

T.E. (Mech.) (Semester – V) (Revised) Examination, November - 2016

CONTROL ENGINEERING

Sub. Code : 66241

Day and Date : Wednesday, 16-11-2016 Total Marks : 100

Time : 2.30 p.m. to 5.30 p.m.

Instructions : 1) All question are compulsory.
2) Assume suitable data wherever required and mention it clearly.
3) Figures to the right indicate full marks.

Q1) a) For the electrical network shown in fig. 1a, construct mechanical system using force current analog. [8]

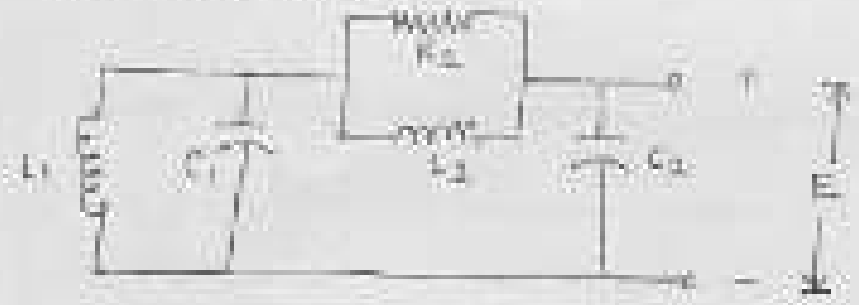

Fig. 1 a

b) Show that the mechanical and electrical system shown in fig. 1 b are analogous system. [6]

Fig. 1 b

P.T.O.

c) Develop a mathematical model for two coupled tank as shown in fig 1 c. [6]

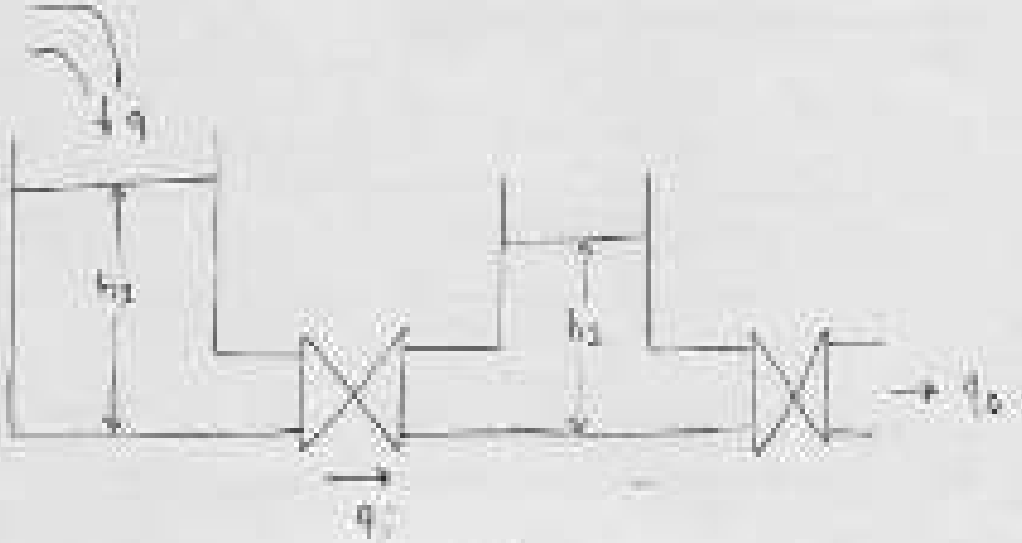

Fig. 1 C

Q2] a) For subsonic flow of air through a restriction, the mass flow rate is $\dot{M} = 1.05\ A\sqrt{\frac{(P_i - P_o)}{T}}P_i$. The area A and temperature T are constants. Determine the linear approximation for mass flow rate. [8]

b) Reduce the block diagram shown in Fig. 2 b and find transfer function.[8]

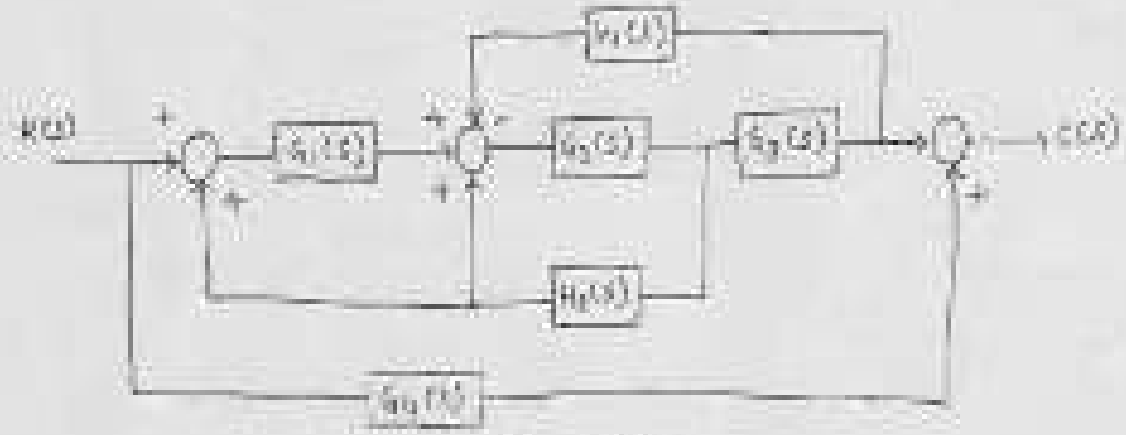

Fig. 2 b

Q3) a) For the unity feedback control system shown in fig. 3a calculate value of k_1 so that system is critically damped. Also calculate maximum overshoot and settling time. [8]

Fig. 3 a

b) A.D.C. position control system is shown in fig. 3b. Determine the response c(t) for r(t) = u(t), d(t) = 0 and all initial conditions are zero. [8]

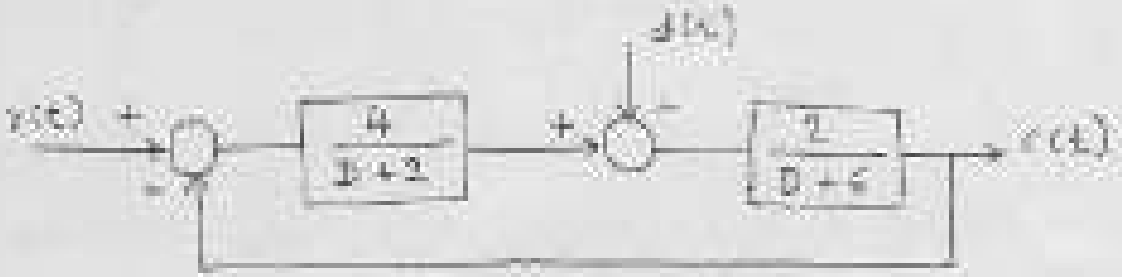

Fig. 3 b

Q4) a) Using Routh's stability criterion, investigate the stability of unity feedback control system whose open loop transfer function is given by

$$G(S)=\frac{Ke^{-s}}{S(S^2+5S+9)} \qquad [6]$$

b) Sketch root locus for system having

$$G(S)H(S)=\frac{K(S^2-4S+20)}{(S+2)(S-4)} \qquad [10]$$

Q5) a) Draw the bode plot for the unity feedback control system with $G(S)=\frac{10(S+10)}{S(S+2)(S+5)}$. From the plot determine values of gain margin and phase margin. [12]

b) Obtain y(t) when u(t) is a unit step for the system shown in fig. 5.b. [6]

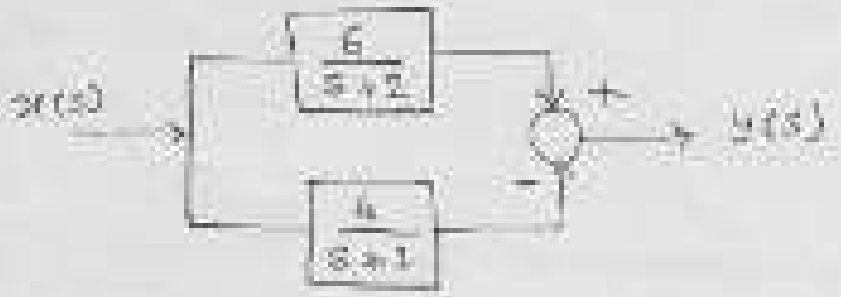

fig. 5. b

Q6) a) Determine state space representation and computer diagram by series programming for the differential equation.

$(D^3 + 3D + 2)y(t) = (D+3)u(t)$ [8]

b) For the differential equation $(D^3 + 9D^2 + 24S + 20)\,y(t) = (D+3)\,R(t)$ determine state space representation and computer diagram by general programming. [8]

+ + +

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Total No. of Pages : 4

Seat No.

T.E. (Mechanical Engineering) (Part-I) (Semester-V) (Revised) Examination, November - 2016

THEORY OF MACHINES-II

Sub. Code: 66242

Day and Date : Saturday, 19 - 11 - 2016 Total Marks : 100

Time : 2.30 p.m. to 5.30 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat labelled sketch wherever necessary.
4) Assume if necessary suitable data and state clearly.
5) Use of Non programmable calculator is permitted.

Q1) a) State and derive the law of Gearing. [8]

OR

Differentiate between involute and Cycloidal tooth profile and define the following terms

i) Pressure angle

ii) Circular pitch

b) A pair of gears having 40 and 10 teeth respectively are of 25° involute form. The addendum length is 5 mm and module pitch is 2.5 mm. If the smaller wheel is driver and rotating at 1000 rpm. Find the velocity of sliding at the point of engagement and at the point of disengagement. [10]

Q2) a) Classification of Gear trains. [8]

OR

Explain the concept of "equivalent mass and moment of inertia" applied for gear trains.

P.T.O.

b) Fig 2 b shows an epicyclic gear train. Pinion A has 15 teeth and is rigidly fixed to the motor shaft. The wheel B has 30 teeth and gears with A, and also with annular fixed wheel D. Pinion C has 15 teeth and is integral with B (C, B being a compound gear wheel). Gear C meshes with annular wheel E, which is keyed to the machine shaft. The arm rotates about the same shaft on which A is fixed and carries the compound wheel B, C. If the motor runs at 1000 rpm, find the speed of the machine shaft. Find the torque exerted on the machine shaft if motor develops a torque of 100 Nm. [10]

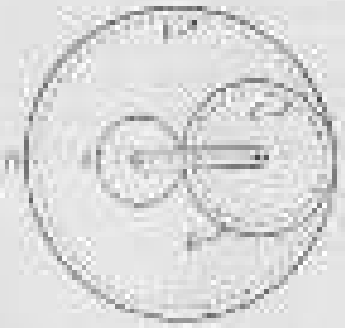

Fig 2 b

Q3] a) Condition for stability of two wheel vehicle moving in a curved path [8]

b) An aeroplane makes a complete half circle of 50 m radius towards left, when flying at 200 km per hour. The rotary engine and the propeller of the plane has a mass of 420 kg with a radius of gyration of 300 mm. The engine runs at 2400 rpm clockwise, when viewed from the rear. Find the gyroscopic couple on the aeroplane and state its effect on it. What will be the effect, if the aeroplane turns to its right instead of to the left? [10]

Q4) a) Derive the equation for correction couple to be applied to make two masses in a system dynamically equivalent. [8]

OR

Derive an expression for velocity and acceleration of the slider of crank mechanism.

b) A vertical engine running at 1200 rpm has a stroke of 110 mm, has a connecting rod 250 mm between centres and centre of the connecting rod is mass 1.25 kg. The mass centre of the connecting rod is 75 mm from the big end centre and when suspended from the gudgeon pin axis makes 21 oscillations in 20 seconds. [10]

i) Calculate the radius of gyration of the connecting rod about an axis through its mass centre.

ii) When the crank is at $\theta = 45°$ from the top dead centre and the piston is moving downwards, find analytically, the acceleration of the piston and the angular acceleration of the connecting rod. Hence find the inertia torque exerted on the crank shaft. To make the two mass system to be dynamically equivalent to the connecting rod, necessary correction couple has to be applied and since the engine is vertical gravity effects are to be considered.

Q5) a) Explain what is multi cylinder inline engine. Also explain conditions to have primary and secondary forces and couple balancing in multi cylinder inline engine. [6]

OR

Explain the balancing of several masses rotating in same plane.

b) The crank and the connecting rod of a 4-cylinder inline engine running at 1800 r.p.m are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine: [12]

i) Unbalanced primary and secondary forces, if any, and

ii) Unbalanced primary and secondary couples with reference to central plane of the engine.

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Total No. of Pages : 3

Seat No.

T.E. (Mech.) (Part - III) (Semester - V)
Examination, November - 2016
HEAT AND MASS TRANSFER
Sub. Code : 66243

Day and Date : Tuesday, 22-11-2016 Total Marks : 100
Time : 2.30 p.m. to 5.30 p.m.

Instructions : 1) All questions are compulsory.
2) Figure to the right indicates full marks.
3) Assume suitable data wherever Necessary and State it clearly.
4) Use of specific calculators is permitted.

Q1) Solve any three:

a) Define critical radius of insulation. Also derive the equation for critical radius of insulation for hollow cylinder. [6]

b) Explain the different modes of mass transfer. Explain with suitable examples. [6]

c) A 0.8 m high and 1.5 m wide double pane window consist of two 4 mm thick layer of glass (k = 78 W/mK) separated by 10 mm wide stagnant air space (k = 0.026 W/mK). Determine the rate of heat transfer through this window when room is maintained at 20C and outside air is at –10C. Take convective heat transfer coefficient as 10 and 40 W/m²K. [6]

d) An aluminum pipe carries a steam at 110C. The pipe (k = 185 W/mK) has a inner diameter of 10 cm and outer diameter of 12 cm. The pipe is located in a room where the ambient air temperature is 30C and convective heat transfer coefficient is 15 W/m²K. Determine heat transfer rate per unit length of pipe. Neglect convective heat transfer on steam side. [6]

P.T.O.

Q2) Solve any two:

a) Derive expression for temperature distribution of a solid cylinder generating heat at the rate of $\dot{q}$ unit per unit volume. [8]

b) Explain Lumped heat capacity analysis. Also give the physical significance of Fourier's number. [8]

c) A solid copper sphere of 10 cm diameter (ρ = 8954 kg/m^3, C_p = 383 J/kg.K, k = 385 W/mK,. Initially at uniform temperature 250°C, it suddenly immersed in a fluid which is maintained at uniform temperature of 50°C. The heat transfer coefficient between sphere and fluid is 200 W/m^{2}K. Determine the temperature of copper sphere at 5 minutes of immersion. [8]

Q3) Solve any two:

a) Derive an expression for temperature distribution along the length of a pin fin having insulated tip. [8]

b) A 1 m long, 5 cm diameter cylinder placed in an atmosphere of 40°C is provided with 12 fins (k = 75 W/mK) 0.75 mm thick. The fins protrudes 2.5 cm from the cylinder surface. The heat transfer coefficient is 23.3 W/m^{2}K. Calculate the rate of heat transfer if the surface temperature of cylinder is at 150°C. [8]

c) Determine thermal conductivity of a long solid 2 cm diameter rod, one end of a rod is inserted in a furnace while remaining portion is projected out in air at 30°C. After steady state has been reached, the temperature at two points on the rod which are 10cm apart are measured and found to be 120°C and 90°C, respectively. If coefficient of heat transfer is 20 W/m^{2}K. What will be thermal conductivity of the rod? [8]

Q4) Solve any three of the following:

a) Analyze the problem of forced convection by using dimensional analysis technique. [5]

b) Write a short note on thermal boundary layer. [5]

c) A vertical cylinder 2m. high and 20 cm in diameter is maintained at a temperature of 130°C in an atmosphere of 30°C. Calculate the heat lost by free convection from this cylinder. The properties of air at 40°C are, $\rho = 1.06$ kg/m³, $C_p = 1008.35$ kg K, $k = 0.028$ W/mK, $\mu = 20 \times 10^{-6}$ N sec/m², $\nu = 18.97 \times 10^{-6}$ m²/sec. Use the correlation $Nu = 0.12 (Gr.Pr)^{1/3}$. [8]

d) 0.5 kg/s quantity of water is heated from 20°C to 40°C by passing through a steel pipe of 2.5 cm diameter which is maintained at 110°C, find the length of the pipe required. The properties of water are $\rho = 978$ kg/m³, $C_p = 4200$ J/kg K, $k = 0.575$ W/mK, $\nu = 0.415 \times 10^{-6}$ m²/sec. Use the correlation $Nu = 0.023\ Re^{0.8}\ Pr^{0.4}$ for turbulent flow and $Nu = 3.65$ if the flow is laminar. [6]

Q5) Solve Any three of the following:

a) State and explain Planks law. [5]

b) What are the various theories of radiation heat transfer? [6]

c) The temperature of a flame in the furnace is 1900 K. Find Monochromatic radiative power at the maximum wavelength. [6]

d) Determine the heat lost per metre length of 8 cm diameter ideal 300°C located in a large room with red brick walls at a temperature of 27°C. Assume emissivity of pipe as 0.78. [6]

Q6) Solve Any three of the following:

a) Derive the expression for effectiveness for parallel flow heat exchanger [6]

b) Define the following terms in connection with heat exchanger [8]

i) LMTD

ii) NTU

iii) Effectiveness

iv) Correction factor

c) Write a short note on design considerations of heat exchanger. [5]

b) Write a short note on Nusselt's theory of film wise condensation. [5]

+ + +

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Total No. of Pages : 4

Seat No.

T.E. (Mechanical) (Part - III) (Semester - V) (Pre-Revised) Examination, November - 2016

MACHINE DESIGN - I

Sub. Code : 66244

Day and Date : Thursday, 24 - 11 - 2016 Total Marks : 100

Time : 3.30 p.m. to 5.30 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Make suitable assumptions wherever required and state them clearly.
4) Use of non-programmable calculator is permitted.
5) Draw neat diagrams wherever necessary.

Q1) Solve any Three: [18]

a) State and explain the various steps involved in design of a machine element.

b) Suggest with justification the suitable material for the following.

i) Leaf Spring in automobile

ii) Utility bed

iii) Helmet (Two Wheeler)

c) Explain the design procedure for a knuckle joint with the help of neat sketch.

d) What is a butt weld joint? Discuss design of butt weld joint under tension.

Q2) a) A turn-buckle used for a stay rope of an electric post subjected to a force of 15 kN. The permissible tensile stress for the steel rods used is 70 MPa. The permissible tensile and shear stress for the cast iron nut used is 30 MPa. Design the turn-buckle. [8]

P.T.O.

b) A cast iron bracket fixed to the steel structure is shown in figure 2a. It supports load P of 25 kN. There are two bolts at A and two bolts at B. The distances are as follows: l_1 = 50 mm l_2 = 200mm l = 400mm. Determine the size of bolts, if maximum permissible tensile stress in the bolts is 50 N/mm². [8]

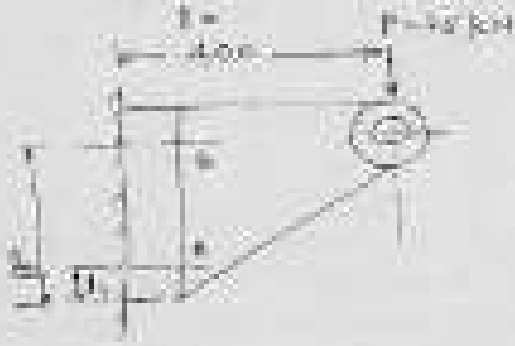


Fig 2a

Designation	Pitch (mm)	Major or Nominal diameter (mm)	Minor or Core diameter (mm)
M30	3.50	30	26.706
M36	4.00	36	31.093
M42	4.50	42	36.479
M48	5.00	48	41.866

OR

b) Figure 2b shows a plate bracket welded to a steel column, and loaded eccentrically. Assuming that the size of weld is 8mm × 6mm, determine the maximum stress induced in the weld.

Fig 2b

Q3) a) Discuss ASME code for shaft design. [6]

b) Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a horizontal belt drive. The pulley weighs 20 kg and is located at 100 mm from the center of nearest bearing. Diameter of the pulley is 200 mm. Maximum power transmitted is 1.1 kW at 720 r.p.m. Angle of lap of belt is 180° and the coefficient of friction between the belt and pulley is 0.3. Shock factors in bending and torsion are 1.5 and 2.0 respectively. Allowable shear stress in the shaft is 35 N/mm². The pulley is mounted over hang on the shaft. [10]

OR

b) It is required to design a rigid type of flange coupling to connect two shafts. The input shaft transmits 37.5 kW power at 180 r.p.m. to the output shaft through the coupling. The design torque is 1.5 times the rated torque. The material for shaft is 40C8 (S_{yt} = 380 N/mm², factor of safety = 2.5), material for key = 30C8 (S_{yt} = 400 N/mm², factor of safety = 2.5), material for flange FG 200 (S_{ut} = 200 N/mm², factor of safety = 6 based on ultimate strength).

Q4) a) Derive an expression for deflection of helical spring of circular wire. [5]

b) Design a close coiled helical compression spring for a service load ranging from 2245N to 2745N. The axial deflection of the spring for this load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420MPa and modulus of rigidity is 84kN/mm². Assume squared and ground ends for coil. Neglect the effect of stress concentration. Draw fully dimensioned sketch of the spring. [11]

Std. wire gauge (SWG) number and corresponding diameter of spring wire is given in the following table.

SWG	6/0	5/0	4/0	3/0	2/0
Diam. mm	11.785	10.973	10.160	9.490	8.839

Q5) a) Derive an expression for torque required to raise the load using square threaded screw. [6]

OR

a) Discuss Various forms of threads used for power transmission giving their relative merits and limitations.

Seat No.

T.E.(Mechanical Engg.) (Semester - V) (Revised) Examination, November - 2016
MANUFACTURING ENGINEERING
Sub. Code :66245

Day and Date :Saturday, 26 - 11 - 2016 Total Marks : 100
Time : 2.30 p.m. to 6.30 p.m.

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume if necessary suitable data and state them clearly.
4) Use of non-programmable calculators is permissible.

SECTION-I

Q1) Solve any two.

a) Derive an expression for Shear strain. State clearly the assumptions made. [8]

b) Explain with neat sketch the types of reamer. [8]

c) In an Orthogonal cutting of the material, Cutting force (F_c) =150kg, Feed force (F_f) =80kg, Rake angle (α)=8°, Chip thickness ratio(r)=0.3.Determine i) Shear force (Fs) and normal to shear force (Fn) ii) Coefficient of friction of chip. [8]

Q2) Solve the following questions.

a) Explain concept of wear & types of wear with sketch. [8]

OR

a) Define machinability. Explain the factors affecting machinability. How the machinability index is defined? [8]

P.T.O.

b) A Tool life of 60 minutes is obtained at a speed of 20m/min and 16 minutes at 40m/min. Determine

i) Taylor's Tool life equation

ii) Cutting speed for 8 minutes of tool life. [8]

Q3) The component shown in fig. is to be processed on a single spindle automat. Study the component and prepare: [18]

a) Detailed process sheet b) Tool Layout

c) Cam profile for drilling operation d) Calculate production rate per hour

Material -ϕ 20 Bronze bar. All dimensions are in mm.

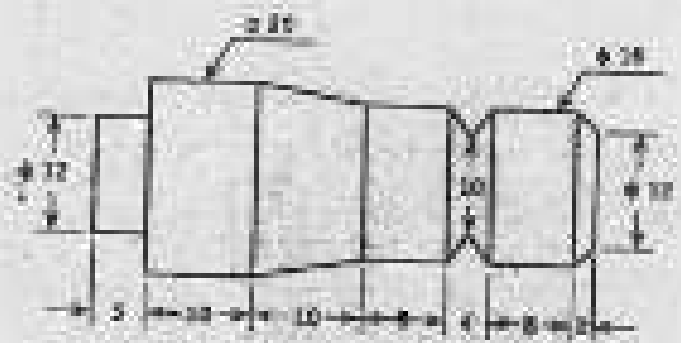


Fig. 1 : Material : ϕ 20 bronze bar.

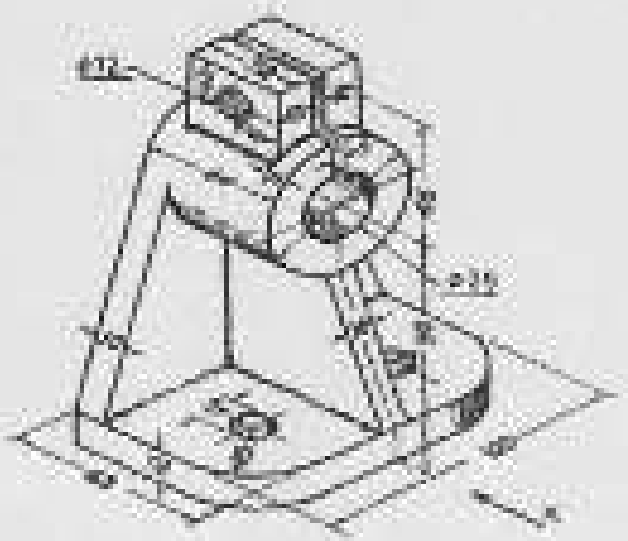
SECTION-II

Q4) a) Design & draw new dimensional drawing in three views with one sectional view of jig for drilling two holes ϕ 12 in the "bottom plate" of the given bracket as shown in figure. [26]

OR

Design & draw neat dimensional drawing in three views with one sectional view of milling fixture for creating slot of 3mm of the given location as shown in figure.

Also justify the selection of location, clamping & guiding elements.



Q5) Solve any two.

a) Explain the importance of following in press working [6]

i) Strippers

ii) Clearance

b) Explain with neat sketch the progressive die. [6]

c) Explain types of stock stop. [6]

Q6) Write short notes on any three [12]

a) Diamond Locator.

b) Automatic Tool changer.

c) Modular tooling system.

d) Strip layout.

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Total No. of Pages : 5

Seat No.	

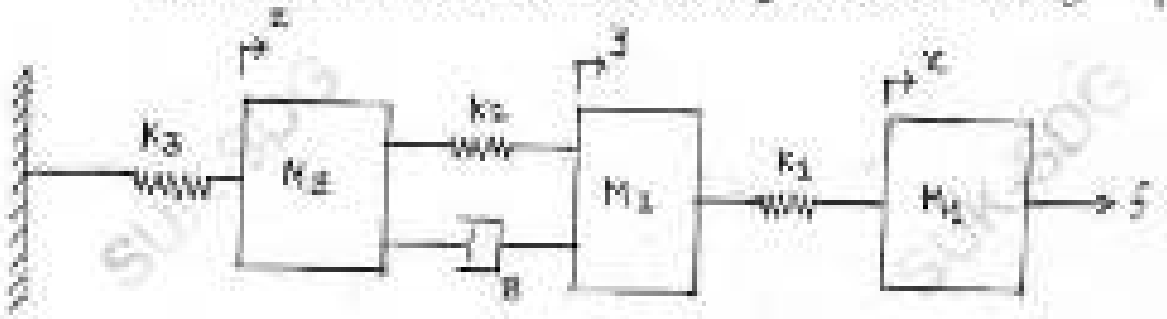
T.E. (Mechanical) (Semester-V)
Examination, May - 2017
CONTROL ENGINEERING
Sub. Code : 66241

Day and Date : Monday, 15-05-2017 Total Marks : 100

Time : 10.00 a.m. to 1.00 p.m.

Instructions : 1) All questions are compulsory.
2) Assume any additional data if required and mention it clearly.
3) Figures to the right indicate full marks.

Q1) a) For the mechanical system shown in fig.1a, construct grounded chair representation and electrical network using force current analog. [6]



b) A block of material at temperature T is placed in an oven which is held at the constant temperature T_a. The rate of heat flow q into the material is given by $q = hA(T_a - T)$, where h is the coefficient of heat transfer of the surface, A is the area of the surface and T is the temperature of the block. The rate of change of temperature of the block is $\frac{dT}{dt} = \frac{q}{MC}$ where M is the mass and C is the average specific heat. Determine the differential equation which describes the temperature of the block as a function of time. Identify the time constant. [6]

P.T.O.

c) For the fluid system shown in fig.1c, determine the equation for pressure P (head H = P/ρ) as a function of inlet pressure P_i. [6]

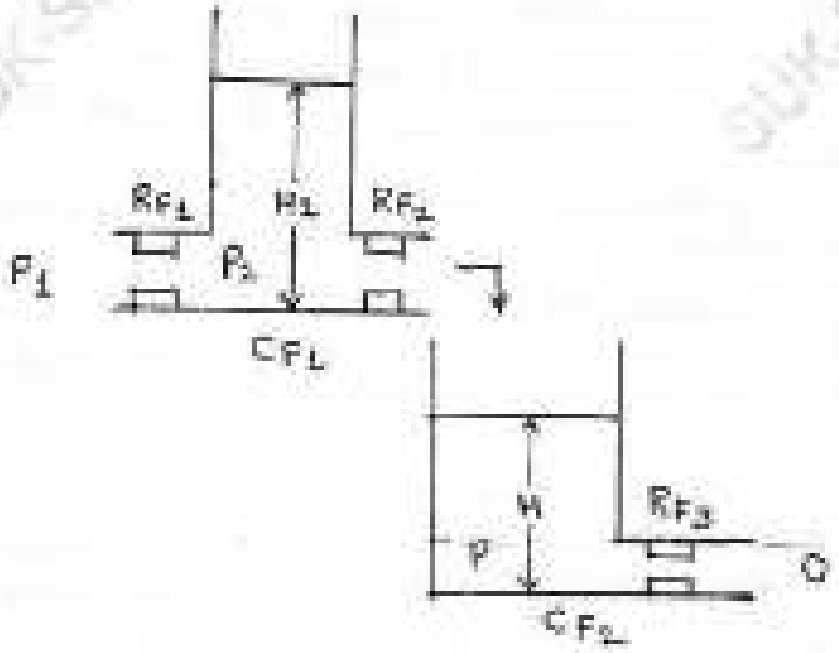


Fig 1 c

Q2) a) For subsonic flow of air through a restriction, the mass flow rate is given by, $M = 1.05A\sqrt{\frac{(P_1-P_2)P_2}{T}}$. The area of restriction A and the temperature T are constants. Determine the linear approximation for mass flow rate due to change in pressure drop $(p_1 - p_2)$ and due to a change p_2 in the downstream pressure. [8]

b) The speed torque curves for a dc motor are shown in fig. 2.1b, where V is the applied voltage, N is the speed and T is the output torque. Determine the linear approximation for the change in torque t due to a change in speed n and a change in voltage v. The motor drives an inertial load such that $t = J\frac{d\omega}{dt}$, where J is the mass moment of inertia. For J = 0.1, determine the differential equation relating the change in speed n to the change in voltage v. Determine the time constant τ and the steady state gain. [8]

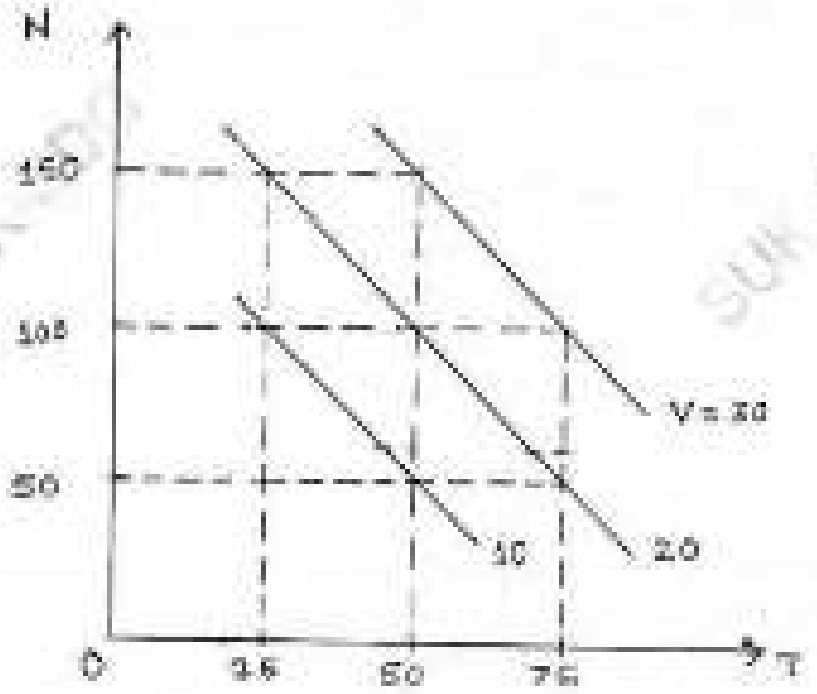


Fig. 2.1 a

OR

b) Reduce the block diagram shown in fig 2.2b and find transfer function.[8]

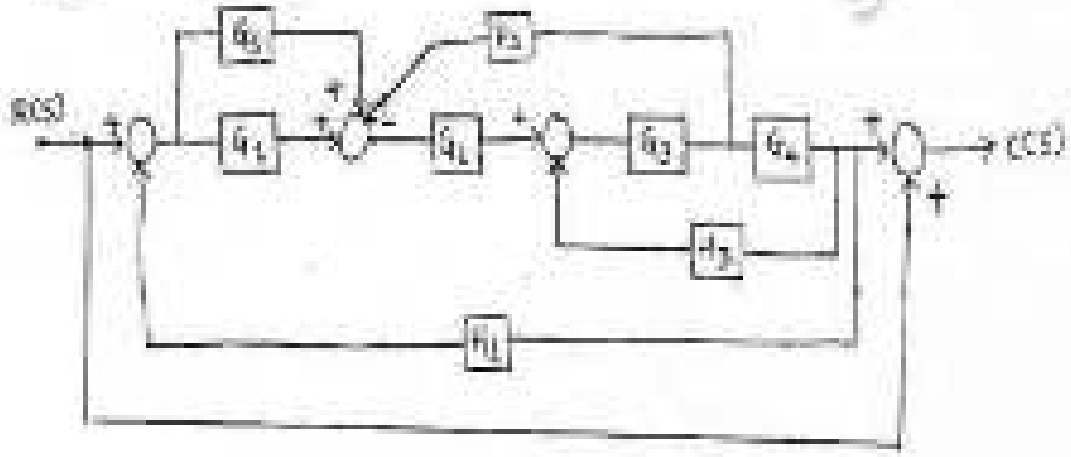


Fig 2.1 b

Q3) a) For the system shown in fig. 3a, find K and K_1 so that maximum overshoot is 10% and settling time is 0.05 sec. [8]

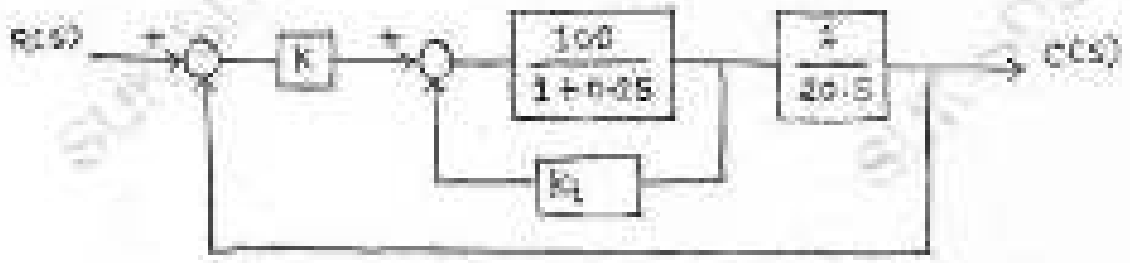


fig . 3 a

b) For the integral control system shown in fig. 3b, determine the value of K and a, such that the characteristics equation has a real root at - 1 and a real root at - 5. For this value of K and a, determine the response c (t) when r (t) = 0, c (0) = 4 and $\dot{c}(0) = 0$. [8]

fig . 3 b

Q4) a) Block diagram for helicopter stabilizing system is shown in fig.4a. Construct root locus plot for this system. [12]

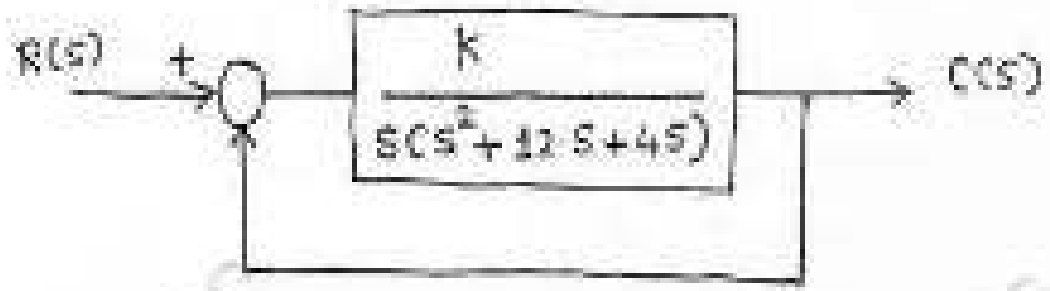


fig . 4 a

b) For the system shown in fig.4b, determine the range of values of K such that the system is stable. [6]

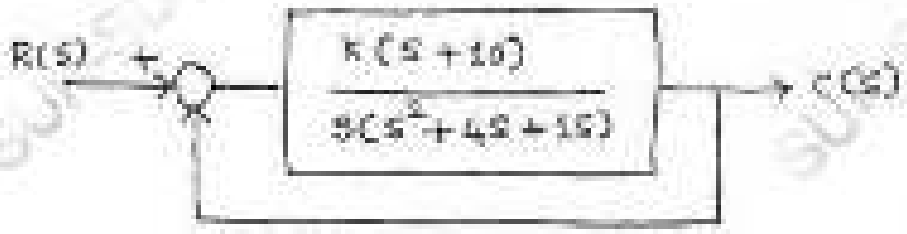


Fig. 4 b

Q5) a) Explain the following terms. [6]

i) Lead compensator

ii) Lag compensator

iii) Lag – Lead compensator

b) Sketch Bode plot for $G(S) = \frac{10}{S(S+1)(S+5)}$ with unity feedback. [10]

Q6) a) The motion of a driverless vehicle is described by the differential equation

$$y(t) = \frac{2(D+5)}{(D+2)(D+3)} f(t)$$

Determine the computer diagram and state space representation by

i) Series programming

ii) General programming [8]

b) For a unity feedback system with an open loop transfer function

$G(S) = \frac{K}{S(S+2)(S+4)}$ find break away point and intersection of root locus with imaginary axis. [8]

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Total No. of Pages : 4

Seat No.	

T.E. (Mechanical Engineering) (Part - I) (Semester - V) (Revised) Examination, May - 2017

THEORY OF MACHINES - II

Sub. Code : 66242

Day and Date : Tuesday, 16 - 05 - 2017 Total Marks : 100

Time : 10.00 a.m. to 1.00 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat labeled sketch wherever necessary.
4) Assume if necessary suitable data and state it clearly.
5) Use of Non programmable calculator is permitted.

Q1) a) State velocity of sliding and prove that the velocity of sliding is proportional to the distance of the point of contact from the pitch point. [8]

OR

Derive an expression for minimum number of teeth required on pinion to avoid interference in mesh with gear.

b) A 20° involute pinion with 20 teeth drives a 50 teeth gear. Module is 8 mm. The contact ratio is to be maximum without interference. Find the two addenda, length of arc of contact and contact ratio. [10]

Q2) a) How the velocity ratio of epicyclic gear train is obtained by tabular method. [6]

OR

Write a note on Inertia geared system.

P.T.O.

b) An epicyclic gear train for an electric motor, is shown in Fig. 2b. The wheel S has 15 teeth and is fixed to motor shaft rotating at 1450 rpm. The planet P has 45 teeth, gears with fixed annular A and rotates on a spindle carried by an arm which is fixed to output shaft. The planet P also gears with the sun wheel S. Find the speed of output shaft. If motor is transmitting 2 HP, find the torque required to fix the annular. [10]

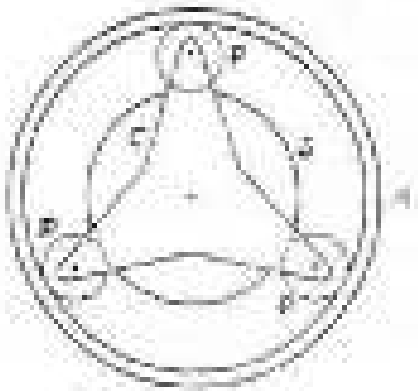

Fig. 2 b

Q3) a) Draw Gyroscopic couple figure and define the following terms: [6]

i) Axis of Spin

ii) Precessional angular motion

iii) Axis of Precession

b) The turbine rotor of ship has a mass of 900 kg and radius of gyration 600 mm. It rotates at 1800 rpm clockwise when looking from the stern. Determine the gyroscopic couple when: [10]

i) The ship is travelling at 40 km/hr and steers to the left in a curve of 100 m radius and its effect;

ii) The ship pitching and the bow is descending with maximum velocity. The pitching is simple harmonic, the periodic time being 30 seconds and the total angular moment between the extreme positions is 12°.

Q4) a) Derive an expression for angular velocity and angular acceleration of the connecting rod. [6]

OR

Derive the equation for correction couple to be applied to make two mass system dynamically equivalent.

b) The connecting rod of a gasoline engine is 300 mm between its centres. It has a mass of 12 kg and mass moment of inertia of 7000 kg - mm^2. Its centre of gravity is at 200 mm from its small end centre. Determine the dynamical equivalent two-mass system of the connecting rod if one of the masses is located at the small end centre. [10]

Q5) a) Explain primary and secondary unbalanced forces of reciprocating masses. Write the maximum values of these forces and the position of the crank at which these maximum values occur. [6]

OR

Explain partial balancing of unbalanced primary force in a reciprocating engine.

b) A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively, and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190°, both being measured in the same sense. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine: [12]

i) The magnitude of the masses at A and D,

ii) The distance between planes A and D; and

iii) The angular position of the mass at D.

Q6) a) Derive the expression for tensile or hoop stress due to centrifugal force in flywheel rim. [6]

b) A multi-cylinder engine is to run at a speed of 600 rpm. On drawing the turning moment diagram to a scale of 1 mm = 250 Nm and 1 mm = 5°, the areas above and below the mean torque line in mm² are:

+160, −172, +168, −191, +197, −162. The speed is to be kept within ± 1% of the mean speed of the engine. Calculate the necessary moment of inertia of the flywheel. Determine the suitable dimensions of a rectangular flywheel rim if the breadth is twice its thickness. The density of the cast iron is 7250 kg/m³ and its hoop stress is 6 MPa. Assume that the rim contributes 92% of the flywheel effects. [10]

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Total No. of Pages : 4

Seat No.	

T.E. (Mechanical) (Part-III) (Semester-V)
(Revised) Examination, May - 2017
HEAT AND MASS TRANSFER
Sub. Code : 66243

Day and Date : Wednesday, 17.05.2017 Total Marks : 100

Time : 10.00 a.m. to 1.00 p.m.

Instructions : 1) All Questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume suitable Data wherever necessary and state it clearly.
4) Use of scientific non programmable calculator is permitted.

Q1) Solve any three.

a) Explain the different modes of heat transfer with suitable example and also give basic law for each one. [6]

b) Define overall heat transfer coefficient, and also derive an expression for overall heat transfer coefficient 'U', for a composite wall having two plates in series with thermal conductivities 'K_1' and 'K_2', having hot fluid at temperature 'T_i' with heat transfer coefficient 'h_i' on one side and cold fluid temperature 'T_o' with heat transfer coefficient 'h_o' on other side. [6]

c) The wall of an oven is 40 cm thick having its thermal conductivity of 0.7 W/mk. The interior surface of the oven is maintained at a temperature of 800°C and the outside wall temperature is 200°C. The total surface area of wall of the oven is $2m^2$. Find the thermal resistance, heat flow rate and the heat flux. [6]

d) A plane wall is 15 cm thick of surface area $4.5m^2$. Thermal conductivity of the wall is 9.5W/mk. The inner and outer surface of the wall is maintained at 150°C and 45°C respectively. Determine, [6]

i) Heat flow rate across the wall.

ii) Temperature gradient in direction of heat flow.

P.T.O.

Q2) Solve the following.

a) Derive the general heat conduction equation in Cartesian co-ordinate system. Also write the special cases of this equation. [8]

OR

b) Derive the equation for temperature distribution and heat transfer for a solid sphere under steady state condition with uniform heat generation and convert it in terms of outside heat transfer coefficient and outside temperature of the fluid 'T_∞'. [8]

c) The steady state temperature distribution in a plane wall is given as,

$T = 600 - 2500x - 12000x^2$, where 'T' is in '°C' and 'x' is in meter measured from the surface of outer wall. One dimensional steady state heat conduction occurs in the wall. Assuming the thermal conductivity (k_{wall} = 2.35 W/mk) and thickness has 0.3 m. Determine, [8]

i) The surface temp. & average temp. of the wall.

ii) The maximum temperature in the wall & its location.

iii) The heat fluxes at the surfaces.

Q3) Solve any two.

a) Write short notes on, [8]

i) Types and classification of fins.

ii) Fin efficiency and fin effectiveness.

b) What do you mean by initial and boundary conditions? What are the types of boundary conditions? [8]

c) Fins are provided to increase the rate of heat transfer from a hot surface. Which of the following will have maximum heat transfer rate: [8]

i) 6 fins of 10 cm length.

ii) 10 fins of 6 cm length.

(Take 'k' for fin = 300 W/mk, h = 20 W/m²k, cross section area of fin = 2 cm², perimeter = 4 cm. Temperature of hot surface = 230°C, Temperature of surrounding air = 50°C)

Q4) Solve any two of the following.

a) Explain the phenomenon of Natural Convection and forced convection. What is mean film temperature and Bulk mean temperature? [8]

b) 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 1 atm and pipe is 15 m long. How much heat is lost by free convection in room. Use correlation $Nu = 0.53 (Gr.Pr)^{1/4}$. Take properties of air as $\rho = 1.0677$ kg/m³, $\mu = 1.9806 \times 10^{-5}$ kg/m.s, Pr = 0.702, $k_f = 0.02813$ W/mK. [8]

c) Air at 20°C and 1.013 bar flows over a flat plate 40 m/s. The plate is 1 m long and is maintained at 60°C. Assuming unit depth, calculate the heat transfer from the plate. Use the correlation: $Nu_L = (Pr)^{1/3}[0.037(Re)^{4/5} - 850]$ Properties of air at 40°C are, $\rho = 1.128$ kg/m³, $C_p = 1.005$ kJ/kg°C, $k = 0.0275$ W/m°C, $\gamma = 16.96 \times 10^{-6}$ m²/s, Pr = 0.699. [8]

Q5) Solve any two of the following.

a) State and Explain: [8]

i) Kirchoff's Law

ii) Wien's Displacement Law

iii) Lambert's Cosine Law

iv) Planck's Law

b) State Planck's law and Stefan Boltzmann law and hence derive Stefan Boltzmann law from Planks law. [8]

c) Calculate the following for an industrial furnace in the form of black body and emitting radiations at 2500°C. [8]

i) Monochromatic emissive power at wavelength 1.2 μm

ii) Wave length at which emission is maximum

iii) Maximum emissive power

iv) Total emissive power

Q6) a) Write short notes on (any two): [12]

i) Types of fouling and its causes

ii) Pool Boiling Curve

iii) Explain classification of heat exchanger with neat sketch.

b) Water at 225 kg/h is to be heated from 35°C to 95°C by means of concentric tube heat exchanger. Oil at 225 kg/h and 210°C with specific heat of 2095 J/kg.K is to be used as hot fluid. If the overall heat transfer coefficient based on outer diameter of the inner tube is 550 W/m²K. Determine the length of heat exchanger, if the outer diameter is 100 mm. [6]

Seat No.	

T.E. (Mechanical) (Part-III) (Semester-V)
(Revised) Examination, May - 2017
MACHINE DESIGN-I
Sub. Code : 66244

Day and Date : Thursday, 18-05-2017 Total Marks : 100
Time : 10.00 a.m. to 1.00 p.m.

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Make suitable assumptions wherever required and state them clearly.
4) Use of non programmable calculator is permitted.
5) Draw neat diagrams wherever necessary.

Q1) Solve any three. [18]

a) Describe various steps involved in design of a machine element.

b) Suggest with justification the suitable material for the following:

i) Side Stand Spring of Bike

ii) Lathe Tail-Stock

iii) Water Bottle

c) Draw neat sketch of a knuckle joint and explain the design procedure.

d) Explain design of butt weld joint under tension.

Q2) a) A turn-buckle used for a stay rope of an electric post is subjected to a force of 15 kN. The permissible tensile stress for the steel rods used is 72 MPa. The permissible tensile and shear stress for the cast iron coupler nut used is 52 MPa. Design and sketch the turn-buckle. [8]

b) A cast iron bracket is fixed to the steel structure as shown in figure 2b. It supports a load P of 30kN. There are two bolts at A and two bolts at B. The distances are as follows: l_1 = 50mm, l_2 = 300mm and l = 600mm. Determine the size of the bolts, if maximum permissible tensile stress in the bolt is 50N/mm^2. [8]

Designation	Pitch (mm)	Major or Nominal diameter(mm)	Minor or Core diameter(mm)
M30	3.50	30	25.706
M36	4.00	36	31.093
M42	4.50	42	36.479
M48	5.00	48	41.866

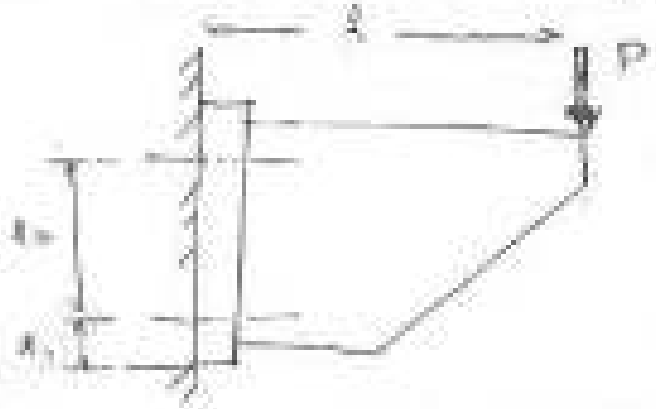


Fig 2b

OR

c) A plate bracket welded to a steel column, and loaded eccentrically is shown in figure 2c. Assuming that the weld is the size of weld is 6mm, determine the maximum stress induced in the weld. Given: b = 150mm, F = 15kN. [8]

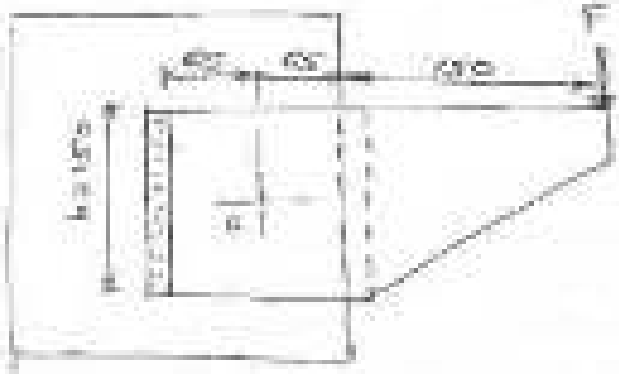


Fig 2c

Q3) a) Demonstrate the use of ASME code for shaft design with suitable example.[6]

b) Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a horizontal belt drive. The pulley weighs 200N and is located at 100 mm from the center of nearest bearing. Diameter of the pulley is 200mm. Maximum power transmitted is 1.2kW at 120r.p.m. Angle of lap of belt is 180° and the coefficient of friction between the belt and pulley is 0.3. Assume shock factors in bending and torsion as 1.5 and 2.0 respectively. Allowable shear stress in the shaft is 35 N/mm². The pulley is mounted overhung on the shaft. [10]

OR

c) Design a rigid type of flange coupling to connect two shafts. The input shaft transmits 37.5 kW power at 180 r.p.m. to the output shaft through the coupling. The design torque is 1.5 times the rated torque. The material for shaft is 40C8 (S_{yt} = 380N/mm², factor of safety = 2.5), material for key = 30C8(S_{yt} = 400N/mm², factor of safety = 2.5), material for flange FG 200 (S_{ut} = 200N/mm², factor of safety = 6.00 based on ultimate strength). [10]

Q4) a) Explain with neat sketches styles of ends of helical compression springs indicating active number of turns in each case. [6]

b) Safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm². It is held on its seat by closed coil helical spring. The maximum lift of valve is 10 mm. Design a suitable compression spring of spring index 5 and providing an initial compression of 35 mm. The maximum shear stress in the material of wire is limited to 500 N/mm². The modulus of rigidity for spring material is 80 kN/mm². Assume squared and ground ends. Calculate: [16]

i) Diameter of spring wire
ii) Mean coil diameter
iii) Number of active turns and
iv) Pitch of the coil

Assume Wahl's Stress factor $K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$

Standard wire gauge (SWG) number and corresponding diameter of spring wire is given in the following table.

SWG	4/0	5/0	6/0	7/0
Diameter (mm)	10.163	10.973	11.785	12.70

Q5) a) Derive an expression for torque required to raise the load using square threaded screw. [6]

OR

a) What do you understand by overhauling and self locking of power screw? Hence deduce the condition for self locking screw. [6]

b) The nominal diameter of triple threaded screw thread is 30 mm, while the pitch is 8 mm. It is used with a collar having outer diameter of 100 mm and inner diameter as 65 mm. The coefficient of friction at thread surface as well as collar surface may be taken as 0.15. The screw is used to raise a load of 15 kN. Using uniform wear theory for collar friction, calculate

i) Torque required to raise the load, [10]

ii) Torque required to lower the load,

iii) The force required to raise the load if applied at a radius of 500 mm

Q6) a) Explain the step by step procedure for selection of Flat belt from Manufacturer's Catalogue. [8]

b) It is require to design a V-belt drive to connect a 20 kW, 1440 rpm. Motor to a compressor running at 480 rpm for 15 hours per day. The space is available for a center distance of approximately 1.2 m. Refer following data. [12]

Determine:

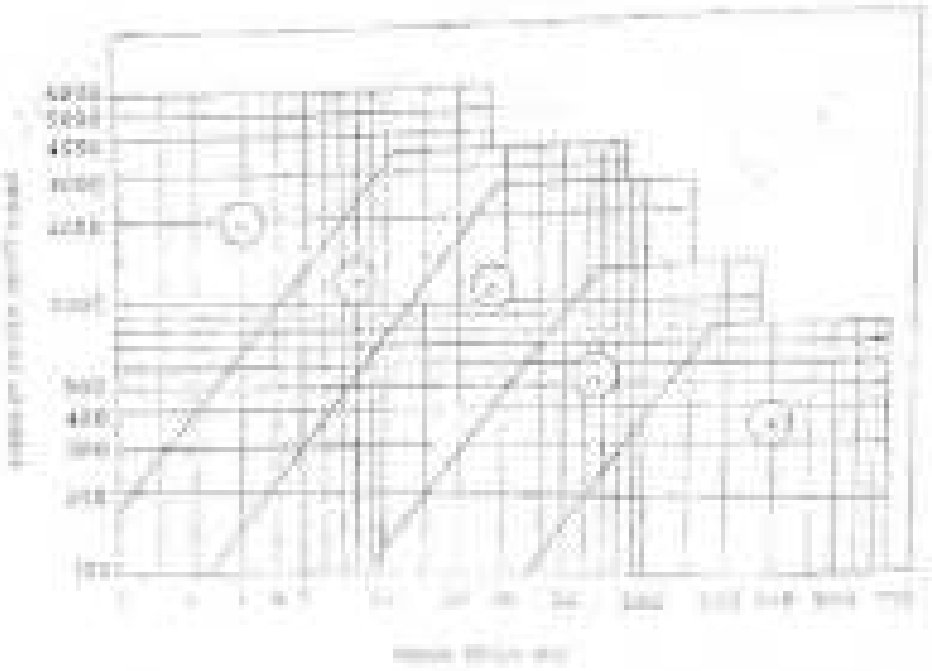
i) Diameters of motor and compressor pulley

ii) Belt specifications

iii) Correct center distance

iv) Number of belts

Data For V Belt Q, No. 6 ()



Section	D									
A	PK									
Section	D									
B	PK									
Section	D									
C	PK									
Section	D									
D	PK									

Dimensions of standard cross-sections

Belt Section	Width W (mm)	Thickness T (mm)	Minimum pitch diameter of pulley (mm)
A	13	8	125
B	17	11	200
C	22	14	300
D	32	19	500
E	38	23	630

For 'V' belts

Series of preferred values for pitch diameters (in mm) are as follows

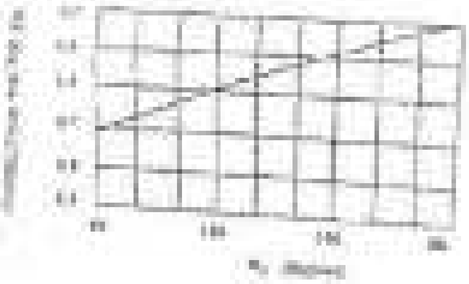
Pitch diameter (mm)	125	132	140	150	160	170	180	190			
200	212	224	236	250	265	280	300	315	335	355	
400	425	450	475	500	530	560	600	630	670	710	
750	800	900	1000								

Correction factor (K_s) for industrial service

Type of service	Operational hours per day		
	3-10	10-16	16-24
1) Light duty, agitators, blowers, centrifugal pumps, fans (up to 7.5 kW) and compressors	1.1	1.2	1.3
2) Medium duty: conveyors, fans (above 7.5 kW), line shafts, machine tools, presses and positive displacement pumps	1.2	1.3	1.4
3) Heavy duty, conveyors, bucket elevators and hammers	1.3	1.4	1.5

Conversion of inside length to pitch length of the belt

Belt Section	A	B	C	D	E
Difference between pitch length and inside length (mm)	36	43	56	79	92



Correction factor for arc of contact (V grooves on both pulleys)

Correction factor [illegible] for belt length
([illegible] length of the belt in mm)

L	Belt section				
	A	B	C	D	E
[illegible]	[illegible]	[illegible]	[illegible]	–	–
[illegible]	[illegible]	[illegible]	–	–	–
[illegible]	[illegible]	–	–	–	–
[illegible]	[illegible]	[illegible]	[illegible]	–	–
[illegible]	[illegible]	[illegible]	[illegible]	–	–
[illegible]	[illegible]	[illegible]	[illegible]	–	–
[illegible]	[illegible]	–	[illegible]	–	–
2464	–	1.02	–	–	–
2540	–	1.03	–	–	–
[illegible]	[illegible]	[illegible]	[illegible]	–	–
[illegible]	[illegible]	[illegible]	[illegible]	–	–
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	–
[illegible]	–	–	[illegible]	–	–
[illegible]	[illegible]	1.06	[illegible]	[illegible]	–
3404	–	–	[illegible]	–	–
[illegible]	–	[illegible]	[illegible]	[illegible]	–
[illegible]	–	[illegible]	[illegible]	[illegible]	–
4115	–	[illegible]	[illegible]	[illegible]	–
[illegible]	–	[illegible]	[illegible]	[illegible]	–
[illegible]	–	[illegible]	[illegible]	[illegible]	–
[illegible]	–	[illegible]	[illegible]	[illegible]	–
[illegible]	–	[illegible]	[illegible]	[illegible]	–
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[illegible]	–	–	[illegible]	[illegible]	[illegible]
[illegible]	–	–	[illegible]	[illegible]	[illegible]

SL-317

Total No. of Pages : 3

Seat No.

T.E. (Mechanical) (Semester - V) (Revised) Examination, May - 2017

MANUFACTURING ENGINEERING

Sub. Code : 66245

Day and Date : Friday, 19 - 05 - 2017 Total Marks : 100

Time : 9.00 a.m. to 1.00 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume if necessary suitable data and state them clearly.
4) Use of non-programmable calculators is permissible.

SECTION - I

Q1) Solve any two:

a) Draw neat sketch of Single point cutting tool and explain different angles provided on single point cutting tool. [8]

b) Explain Orthogonal & Oblique Cutting Operation with neat sketch. [8]

c) During orthogonal turning operation of, following observations were made. Cutting force(Ft)=15kg, Feed force(Fv)=6kg, Rake angle(α)=10°, Feed(t_1)=0.2mm, Chip thikness(t_2)=0.4mm. Cutting Speed(V)=60m/min. Find out, [8]

i) Shear angle.

ii) Workdone in shear and

iii) Shear strain.

Q2) Solve the following questions.

a) Explain concept of Heat generation in metal cutting & use of coolants. [8]

OR

a) Explain with sketch various types of drill. [8]

b) The tool life of a Single point cutting tool is 10 minutes when it is operated at 240m /min. At what speed it should be operated in order to have a tool life of 180 minutes. Assume n=0.3 [8]

P.T.O.

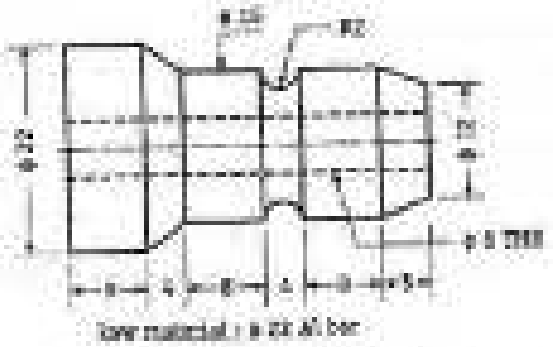
Q3) The component shown in fig. is to be processed on a single spindle automat. Study the component and prepare: [18]

a) Detailed process sheet.

b) Tool Layout.

c) Cam profile for drilling operation.

d) Calculate Production rate per hour.



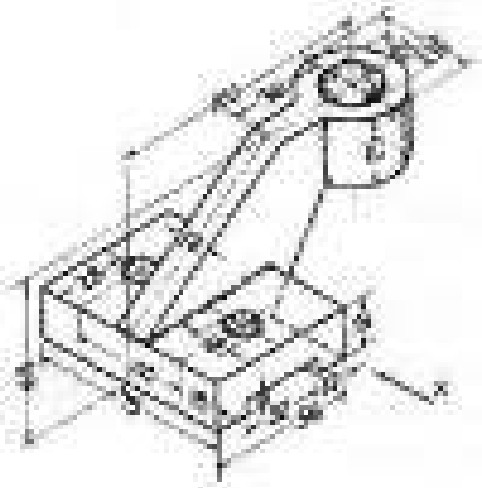
Material : Al bar of Ø 22. All dimensions are in mm.

SECTION - II

Q4) Design & draw neat dimensional drawing in three views with one sectional view of jig for drilling two holes ϕ12 as shown in figure. [26]

OR

Design & draw neat dimensional drawing in three views with one sectional view of Milling fixture for face milling of ϕ36 to maintain the height of 25mm. Also Justify the selection of location, clamping & guiding elements.



Q5) Solve any two. [12]

a) Explain with sketch nomenclature of Press Tool. [6]

b) Write design considerations for die element. [6]

c) Explain different types of strippers. [6]

Q6) Write short notes on any three. [12]

a) Construction & working of CNC.

b) Automatic Tool Changer.

c) Modular Tooling System.

d) Comparison between NC and CNC machines.

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SV-83

Total No. of Pages : 2

Seat No.	

T.E. (Mechanical Engineering) (Part-III) (Semester - V)
(Revised) Examination, April - 2018
THEORY OF MACHINES - II
Sub. Code : 66242

Day and Date : Wednesday, 25 - 4 - 2018 Total Marks : 100

Time : 10.00 a.m. to 1.00 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat labeled sketch wherever necessary.
4) Assume if necessary suitable data and state clearly.
5) Use of Non programmable calculator is permitted.

Q1) a) Derive an expression for the centre distance for a pair of spiral gears and define the following terms. [8]

i) Normal pitch

ii) Axial pitch

OR

Prove that the condition for maximum efficiency in case of spiral gear is $\alpha = \frac{\theta + \phi}{2}$ where, ϕ = friction angle, θ = shaft angle and α = spiral angle on the driving wheel.

b) Two involute gears of 20° pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm and the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module, find the maximum velocity of sliding. [10]

Q2) a) Explain the working of Differential gear of an automobile. [6]

OR

Explain the concept of equivalent mass and moment of inertia applied for gear trains.

P.T.O.

b) Fig. 2 b shows an epicyclic gear train. Gear 'A' is fixed to the frame and is therefore stationary. The arm 'B' and gear 'C' and 'D' are free to rotate on the shaft. Gears 'A', 'C' and 'D' have 100, 101 and 99 teeth respectively. Pitch circle diameters of all are the same so that the planet gear 'P' meshes with all of them. Determine the revolutions of gears 'C' and 'D' for a revolution of the arm 'B'. [10]

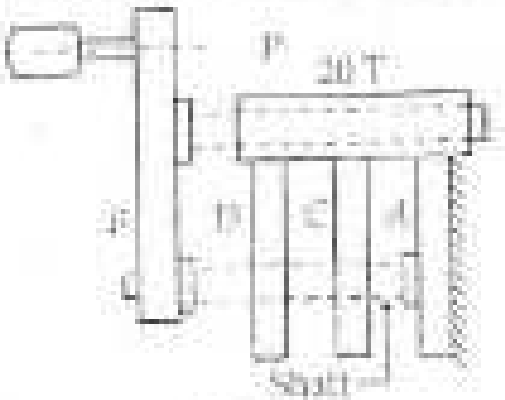

Fig. 2 b

Q3) a) Derive the expression for gyroscopic couple magnitude. [6]

b) A two wheeler of 400 mm wheel radius is negotiating a turn of radius 60 m at speed of 100 km/h. The combined mass of vehicle with its rider is 300 kg. The C.G. of rider is 0.6 m above ground level. The mass moment of inertia of engine flywheel is 0.3 kg-m^2 and moment of inertia of each road wheel is 1 kg-m^2. If the speed of the engine is five time the speed of the wheel and in the same direction, find the angle of heel of vehicle. [10]

Q4) a) Derive an expression for velocity and acceleration of the slider of slider crank mechanism. [6]

OR

Explain dynamically equivalent system to replace connecting rod by a two mass system.

b) The connecting rod of a vertical reciprocating engine is 2 m long between centres and weighs 250 kg. The mass centre is 800 mm from the big end bearing. When suspended as a pendulum from the gudgeon pin axis, it makes 8 complete oscillations in 22 seconds. Calculate the radius of the gyration of the rod about an axis through its mass centre. The crank is 400 mm long and rotates at 200 rpm. Find the inertia torque exerted on the crankshaft when the crank has turned through 40° from the top dead centre and the piston is moving downwards. [10]

Q5) a) Explain direct and reverse crank method for balancing of the radial engine. [6]

OR

Explain what is multi cylinder inline engine. Also explain conditions to have primary and secondary forces and couple balancing in multi cylinder in line engine.

b) Four masses A, B, C and D as shown below are to be balanced. [12]

	A	B	C	D
Mass (kg)	—	30	50	40
Radius (mm)	150	240	120	150

The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90°. B and C makes angles of 210° and 120° respectively with D in the same sense.

Find:

i) The magnitude and the angular position of mass A, and

ii) The positions of planes A and D.

Q6) a) Explain maximum fluctuation of energy and coefficient of fluctuation of energy. [6]

b) The turning moment diagram for a multi cylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm = 2° horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows:

+52, −124, +92, −140, +85, −72 and +107 mm², when the engine is running at a speed of 600 rpm. If the total fluctuation of speed ±15% of the mean, find the necessary mass of the flywheel of radius 0.5 m. [10]

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Total No. of Pages : 3

Seat No.	

T.E. (Mechanical) (Part-III) (Semester - V) (Revised) Examination, April - 2018

HEAT AND MASS TRANSFER

Sub. Code : 66243

Day and Date : Thursday, 26 - 04 - 2018 Total Marks : 100

Time : 10.00 a.m. to 1.00 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume Suitable Data wherever necessary and state it Clearly.
4) Use of scientific non programmable calculator is permitted.

Q1) Solve any three:

a) Define critical radius of insulation. Also derive the equation for critical radius of insulation for hollow cylinder. [6]

b) What are the modes of mass transfer? Explain Fick's law of diffusion. [6]

c) Air at 90°C flows in a copper tube (k = 384 W/mK) of 4 cm inner diameter and with 0.6 cm thick walls which are heated from the outside by water at 125°C. A scale of 0.3 cm thick is deposited on outer surface of the tube whose thermal conductivity is 1.75 W/mK. The air and water side heat transfer coefficients are 221 and 3605 W/m²K, respectively. Find overall heat transfer coefficient on the outside area basis. [6]

d) A steam pipe is covered with two layers of insulation. The inner layer (k = 0.17 W/mK) is 30 mm thick and the outer layer (k = 0.093 W/mK) is 50 mm thick. The pipe is made of steel (k = 58 W/mK) and has inner diameter and outer diameter of 160 and 170 mm, respectively. The temperature of saturated steam is 300°C and The ambient air is at 50°C. If the inside and outside heat transfer coefficients are 30 and 5.8 W/m²K, respectively, calculate the rate of heat loss per unit length of pipe. [6]

Q2) Solve any two:

a) Steel ball bearings (k = 50 W/mK, $\alpha = 1.3 \times 10^{-5}$ m²/s) having a diameter of 40 mm are heated to a temperature of 650°C and then quenched in a tank of oil @ 55°C. If the heat transfer coefficient between ball-bearings and oil is 300 W/m²K. Determine the duration of time the bearing must remain in an oil to reach a temperature of 200°C. [8]

P.T.O.

b) A plate 2 cm thick and 2 cm wide is used to heat a fluid at 30°C. The heat generation rate inside the plate is 7×10^6 W/m^3. Determine heat transfer coefficient to maintain the temperature of the plate below 180°C. Take k for plate 26 W/mK. Neglect heat losses from the edge of plate. [8]

c) Derive the equation for temperature distribution & heat transfer through a plane wall with uniform heat generation; also convert this equation in terms of ambient temperature & the heat transfer coefficient. [8]

Q3) Solve any two:

a) Explain the error estimation of temperature measurement in thermo-well. [8]

b) Derive the expression for temperature distribution for a short fin with convective tip. [8]

c) An aluminum alloy fin (k = 200 W/mK), 3.5 mm thick and 2.5 cm long protrudes from the wall. The base is at 420°C and ambient air temperature is 30°C. The heat transfer coefficient may be taken as 11 W/m^{2}K. Find the heat loss and fin efficiency, if the heat loss from the fin tip is negligible. [8]

Q4) Solve any two of the following:

a) Give the physical significance of [8]
   i) Nusselt Number
   ii) Grashoff's Number
   iii) Reynolds Number
   iv) Prandtl Number

b) Assuming a man as a cylinder of 40 cm diameter and 1.72 m height with surface temperature of 37°C. Calculate the heat loss from his body while standing in wind flowing at 20 km/hr at 17°C. Use following correlation: [8]

   $Nu = 0.027\ Re^{0.805}\ Pr^{1/3}$

   The properties of fluid at mean film temperature are $\rho = 1.1614$ kg/m^3, $\vartheta = 184.6\times10^{-7}$ Ns/m^2, Pr = 0.707, k = 0.0263 W/mK.

c) Estimate the heat transfer rate from 100 watt incandescent bulb at 140°C to an ambient air at 24°C. Approximate the bulb as 60 cm diameter sphere and calculate percentage loss by natural convection. Use following correlation; [8]

   $Nu = 0.60\ [Gr.Pr]^{1/4}$

   The properties of air at 82°C are kinematic viscosity(γ) = 21.46×10^{-6} m^2/s, K = 30.38×10^{-3} W/mK, Pr = 0.699.

Q5) Solve any two of the following:

a) Write short Note on: [8]

i) Radiation shape factor

ii) State and prove Kirchhoff's Law

b) Write Plank's law and derive Stefan Boltzmann law from Plank's law. [8]

c) Calculate the following for an industrial furnace in the form of black body and emitting radiations at 2500°C. [8]

i) Monochromatic emissive power at wavelength 1.2 μm

ii) Wavelength at which emission is maximum

iii) Maximum emissive power

iv) Total emissive power

Q6) a) Write short notes on: [12]

i) Define Fouling factor and explain causes of fouling

ii) Types of Condensation and boiling

b) Hot oil with capacity rate ($\dot{m} \times C_p$) of 2500 W/K flows through a double pipe heat exchanger. It enters at 360°C and leaves at 300°C. Cold fluid enters at 30°C and leaves at 200°C. If overall heat transfer coefficient (U) is 800 W/m²K, determine the heat exchanger area required for parallel and counter flow. [6]

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Total No. of Pages : 4

Seat No.	

T.E. (Mechanical) (Part -III) (Semester - V) (Revised)

Examination, April - 2018

MACHINE DESIGN-I

Sub. Code: 66244

Day and Date : Friday, 27 - 04 - 2018 Total Marks : 100

Time : 10.00 a.m. to 1.30 p.m.

Instructions:
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Make suitable assumptions wherever required and state them clearly.
4) Use of non-programmable calculator is permitted.
5) Draw neat diagrams wherever necessary.

Q1) Solve any Three: [18]

a) Discuss the guidelines for the selection of quantitative values of 'factor of safety'.

b) Suggest with justification the suitable material for the following:

i) Large Flywheel

ii) Helical spring

iii) Dairy Equipment

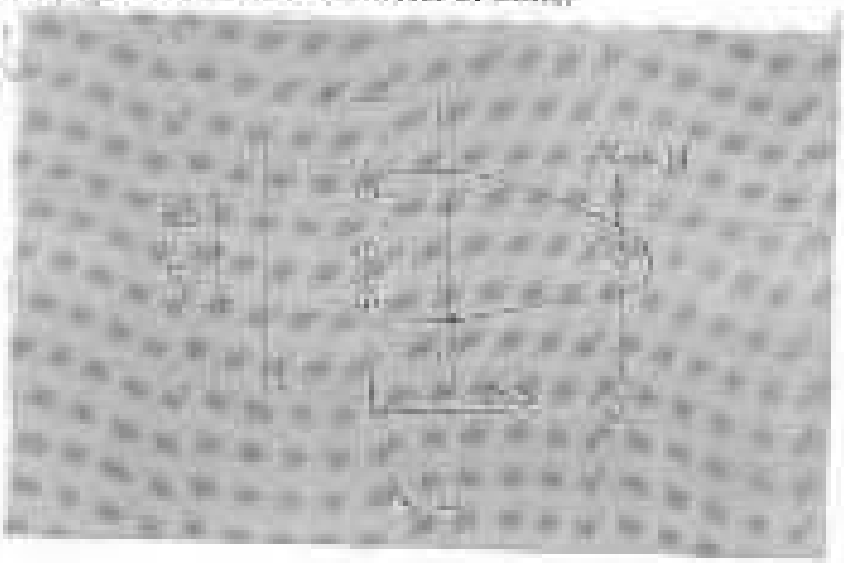
c) Discuss the design of a bell-crank lever.

d) Discuss different types of stresses in bolt design.

Q2) a) A knuckle joint used to connect two mild steel rods has to transmit a tensile load of 200 kN. Given: yield point strength of the material in tension 200 N/mm^2 and factor of safety = 2. Allowable stress in compression is two times the allowable stress in tension, and allowable stress in shear as 0.707 times that in tension. Design the knuckle joint. [8]

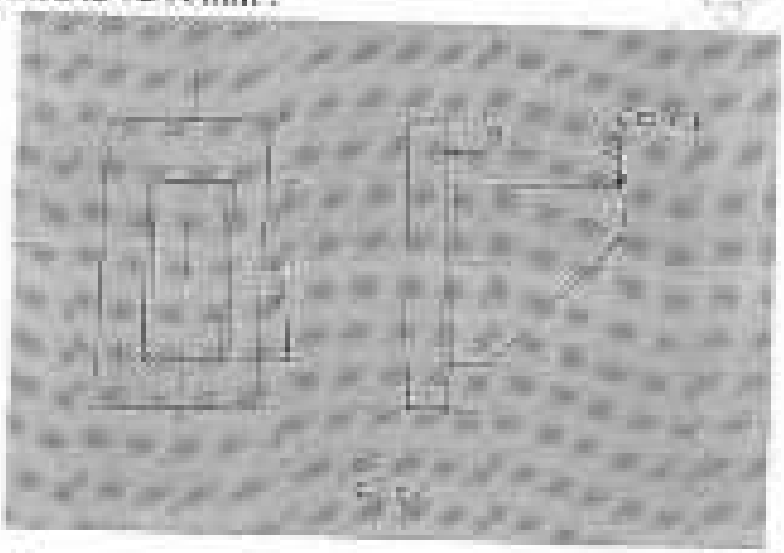
P.T.O.

b) A steel plate is subjected to a force of 6 kN and fixed to the channel by means of three identical bolts as shown in figure 2b. The bolts are made of plain carbon steel 30C8(S_{yt} =400N/mm², factor of safety = 3) Determine the nominal diameter of bolts. [8]



OR

c) Figure 2c shows a bracket is welded to the vertical plate by means of two fillet welds. Determine the size of welds if the permissible shear stress is limited to 72 N/mm². [8]



Q3) a) What are various types of keys? Compare stresses in woodruff key with flat key? [6]

b) The propeller shaft is required to transmit 45 kW power at 500 rpm. It is a hollow shaft made of plain carbon steel and the permissible shear stress is 84 N/mm². Calculate the inside and outside diameters of the shaft for [10]

i) Ratio of an inside diameter 0.6 times the outside diameter.

ii) Ratio of an inside diameter 0.65 times the outside diameter.

Determine the % saving in material by modifying the ratio.

OR

b) Design a bushed-pin type flexible coupling for connecting a motor shaft to a compressor, with the following service conditions:

Power to be transmitted = 50kW

Speed of motor shaft = 1000r.p.m

Diameter of motor and compressor shaft = 55mm

Bearing pressure on the rubber bush = 0.7 N/mm²

Allowable stress in the pins = 40 Mpa

Allowable shear stress in the keys and shafts = 45 Mpa

Allowable crushing stress in the keys = 60 MPa

Allowable shear stress in the flange material = 15 Mpa

Q4) a) Explain with neat sketches, the stresses induced in helical spring of circular cross section. [6]

b) Design helical compression spring for a maximum load of 1000 N for deflection of 25 mm using the valve having spring index of 5. The maximum permissible shear stress for spring wire is 420 MPa and modulus of rigidity is 84 kN/mm². Assume squared and ground ends. [10]

Assume Whal's Stress factor $K=\frac{4C-1}{4C-4}+\frac{0.615}{C}$

Where C - spring index

SWG	1	2	3	4	5
Diam. mm	7.620	7.010	6.401	5.893	5.385

Q5) a) Discuss Various forms of threads used for power transmission giving their relative merits and limitations. [6]

OR

a) Derive an expression for maximum efficiency for square threaded screw.

b) The cutter of machine is pulled by square threaded screw of 55 mm external diameter and pitch of 10 mm. The operating nut takes the axial load of 400 N on a flat surface of 60 mm and 90 mm internal and external diameter respectively. If the coefficient of friction is 0.15 for all contact surfaces on nut. Determine power required to rotate operating nut when cutting speed is 6m/min. Also find efficiency of the screw. [12]

Q6) a) Explain the step by step procedure for selection of V belt from Manufacturer's Catalogue. [6]

b) It is required to select flat belt drive to connect two transmission shafts rotating at 300 rpm and 400 rpm respectively. The centre to centre distance between the shafts is approximately 3m and the belt drive is open type. The power transmitted by the belt is 30 kW. The load correction factor is 1.3. The belt should operate at velocity between 17.80 m/s to 22.90 m/s. The power transmitting capacity of the belt per mm width per ply at 180° arc of contact and at a belt velocity of 5.08 m/s is 0.0147 kW. Select preferred pulley diameters and specify the belt. Refer the tables given below: [10]

Arc of Contact Factor (F_c)

θ, (Deg)	130	140	150	160	170	180	190	200
F_c	1.26	1.19	1.13	1.08	1.04	1.00	0.97	0.94

Standard Widths of these belts in mm

3 - Ply	25	40	50	63	76					
4 - Ply	40	44	50	63	76	90	100	112	125	132
5 - Ply	76	100	112	125	152					
6 - Ply	112	125	152	180	200					

For flat pulleys: Series of preferred values of pitch diameters (in mm) are as follows

Pitch diameter(mm):	125	132	140	150	160	170	180	190	200
212	224	236	250	265	280	300	315	355	375
400	425	450	475	500	530	560	600	630	670
710	750	800	900	1000					

EEE

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Total No. of Pages : 3

Seat No.	

T.E. (M) (Semester - V) Examination, April - 2019

CONTROL ENGINEERING

Sub. Code: 66241

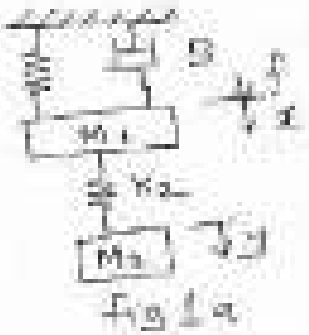
Day and Date : Thursday, 25 - 04 - 2019 Total Marks : 100

Time : 2.30 p.m. to 5.30 p.m.

Instructions: 1) All questions are compulsory.

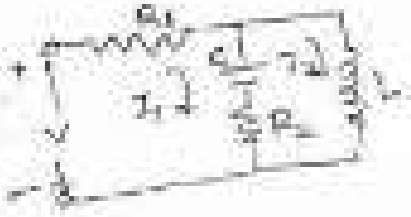
2) Assume suitable data if required and mention it clearly.

Q1) a) For the mechanical system shown in Fig. 1a construct grounded chair representation and find equation relating f to x and x to y [6]



b) Explain mathematical model of hydraulic system. [6]

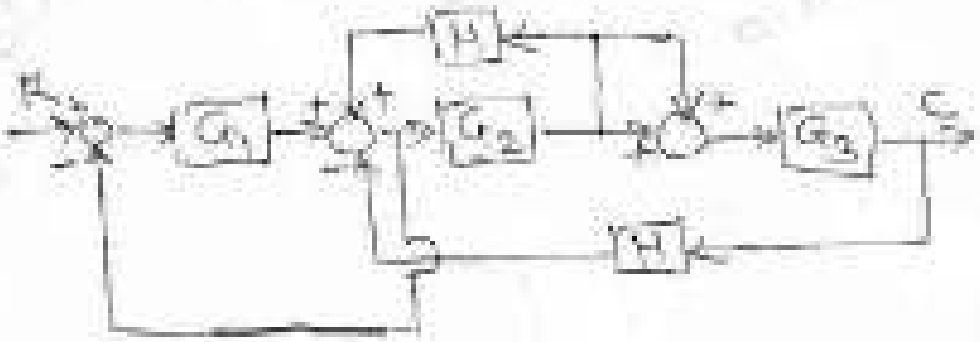
c) Construct direct and Inverse analog for Electrical circuit shown in fig. Find mechanical circuit with equations. [6]



P.T.O.

Q2) a) What do you mean by linearization of non-linear function. Explain geometric, interpretation of error in the measurement of area of a rectangle having width W and length l. [5]

b) Find the transfer function for the block diagram shown in fig. [5]



Q3) a) Pole zero configuration of the overall transfer function is shown in fig. Determine its response for unit step input. [8]

b) The step response of a second order control, control system is shown in figure. Determine closed loop transfer function of the system. [8]

Q4) a) Using Routh stability criterion. Determine stability of system having its open loop transfer function has poles at $s = 0$, $s = -1$, $s = -3$ and zero at $s = -5$ take gain $k = 10$. [8]

b) Sketch root locus for $G(s).H(s) = \dfrac{k(s+2)}{s[s+1-j\sqrt{3}][s+1+j\sqrt{3}]}$. [10]

Q5) a) Draw bode plot for transfer function $G(s) = \dfrac{1000}{s[1+0.1s][1+0.01s]}$

Determine gain margin and phase margin. [10]

b) Calculate break in point and angle of departure for control system given by characteristic equation $s^2 + 2s + 3 + k(s+2) = 0$. [6]

Q6) a) Determine state space representation and computer diagram using series programming $\dfrac{x(t)}{f(t)} = \dfrac{2(D+5)}{(D+2)(D+3)(D+4)}$. [8]

b) Determine state space representation and computer diagram using general programming $\dfrac{y(t)}{f(t)} = \dfrac{D+3}{D^3+9D^2+21D+20}$. [8]

⌘⌘⌘

Seat No.	

SV-86
Total No. of Pages : 3

T.E. (Mechanical) (Semester - V) (Revised) Examination, April - 2018
MANUFACTURING ENGINEERING (Paper - III)
Sub. Code: 66245

Day and Date : Saturday, 28 - 04 - 2018
Time : 9.30 a.m. to 1.30 p.m.

Total Marks : 100

Instructions :
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume if necessary suitable data and state them clearly.
4) Use of non programmable calculators is permissible.

SECTION - I

Q1) Solve any two :

a) Draw neat sketch of a Single point cutting tool and explain different angles provided on single point cutting tool. [8]

b) Explain Orthogonal & Oblique Cutting Operation with neat sketch. [8]

c) During orthogonal turning operation of following observations were made. Cutting force (Fh) = 15 Kg, Feed force (Fv) = 6 Kg, Rake angle (α) = 10°, Feed (t_1) = 0.2 mm, Chip thickness (t_2) = 0.4 mm. Cutting Speed (V) = 60 m/min. Find out : [8]

i) Shear angle.

ii) Workdone in shear and

iii) Shear strain.

Q2) Solve the following questions :

a) Explain concept of Heat generation in metal cutting & use of coolants. [8]

OR

a) Explain with sketch various types of drill. [8]

b) The tool life of a Single point cutting tool is 10minutes when it is operated at 240 m/min. At what speed it should be operated in order to have a tool life of 180 minutes. Assume n = 0.2. [8]

P.T.O.

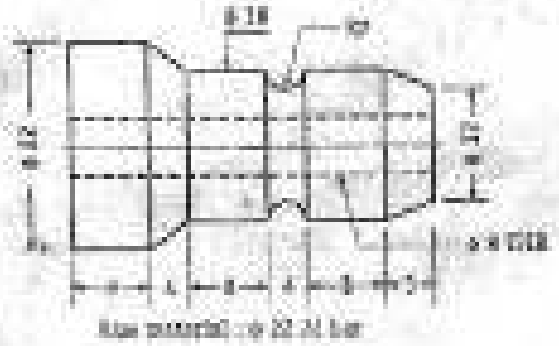
Q3) The component shown in fig. is to be processed on a single spindle automat. Study the component and prepare : [18]

a) Detailed process sheet.

b) Tool Layout.

c) Cam profile for drilling operation ϕ8 through

d) Calculate Production rate per hour.



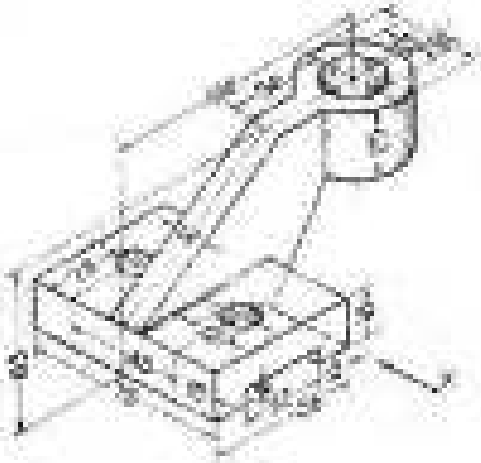
Material – Al bar of ϕ 32. All dimensions are in mm.

SECTION - II

Q4) Design & draw neat dimensional drawing in three views with one sectional view of jig for drilling two holes ϕ12 as shown in figure. [26]

OR

Desing & draw neat dimensional drawing in three views with one sectional view of Milling fixture for face milling of ϕ36 to maintain the height of 25 mm. Also Justify the selection of location, clamping & guiding elements.



Q5) Solve any two :

a) Explain with sketch nomenclature of Press Tool. [6]

b) Write design considerations for die element. [6]

c) Explain different types of strippers. [6]

Q6) Write short notes on any three : [12]

a) Construction & working of CNC.

b) Automatic Tool Changer.

c) Modular Tooling System.

d) Comparison between NC and CNC machines.

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Total No. of Pages : 3

Seat No.

T.E. (Mechanical Engineering) (Part - I) (Semester - V)
Examination, April - 2019
THEORY OF MACHINES-II
Sub. Code: 66242

Day and Date : Saturday, 27 - 04 - 2019 Total Marks : 100

Time : 2.30 p.m. to 5.30 p.m.

Instructions:
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Make suitable assumptions wherever required and state them clearly.
4) Use of non-programmable calculator is permitted.
5) Draw neat diagram wherever necessary.

Q1) a) Derive the expression for maximum efficiency in case of spiral gear. [5]

OR

Derive the equation for center distance of a spiral gear pair.

b) A pinion having 30 teeth drives a gear having 80 teeth. The Profile of the gears is involute with 20 degree pressure angle, 12mm module and 10 mm addendum. Find the length of path of contact, arc of contact, contact ratio and the maximum velocity of sliding if the pinion rotates at 105 r.p.m. [10]

Q2) a) Compare the gear trains based on speed ratio, Power transmitted, efficiency and application. [6]

OR

What do you mean by braking or the fixing torque of a gear in epicyclic gear train? How can it be measured? [6]

P.T.O.

b) In an epicyclic gear train shown in figure 2b, the wheel A is fixed wheel, wheels B and C are compound and mounted on one pin. If the arm F makes 600 rpm counter clockwise, find the speed and direction of rotation of wheels D and E. Number of teeth on gears A,B,C,D and E are 30,20,40,25 and 50 respectively. [10]

fig 2b

Q3) a) Derive an expression for angle of heel of a two wheeler taking a turn.[6]

b) A racing car of mass 2500 kg has a Wheel base of 2.5 m and a track of 1.5 m. The center of gravity of the vehicle is located at 0.5 m above ground and 1.5 m from front axle. The diameter of each wheel is 0.80m and mass moment of inertia 0.77 kg-m^2. The driveshaft, engine flywheel and transmission are rotating in clockwise direction when viewed from front with equivalent mass 120 kg with radius of gyration 15cm. Determine load distribution on the wheels if the car is rounding a curve at 100 m radius at 200 km/hr. Investigate for left turn rounding. Assume G=4.[10]

Q4) a) Derive the equation for natural frequency of compound pendulum. [6]

OR

Derive the equation for velocity and acceleration of slider in reciprocating engine mechanism. [6]

b) In a double acting vertical steam engine running at 360 rpm, cylinder bore diameter is 25cm, stroke is 30 cm, diameter of piston rod is 3.75 cm and length of connecting rod is 60 cm. When the crank has turned 120° from top dead center, the pressure of steam at cover end is 35×10^4 N/m^2 and at the crank end is 1×10^4 N/m^2. If the mass of reciprocating parts is 45kg, find piston effort and turning moment on the crank shaft for the given crank position. [10]

Q5) a) Explain direct and reverse crank method used in balancing of radial engines. [6]

OR

Explain balancing of single revolving mass in different way. [6]

b) A shaft carries four rotating masses A,B,C and D in this order along the shaft and are concentrated at radii of 12cm and 15cm, 14 cm and 18cm respectively. The masses at A,C and D are 15 kg, 10kg and 8kg respectively. The planes of rotation of A and B are 15 cm apart and of B and C are 18cm apart.The angle between the radii of A and C is 90°. If the shaft is in complete dynamic balance, determine;

i) The angles between the radii of A,B and D.
ii) The distance between the planes of rotation of C and D.
iii) The mass at B. [12]

Q6) a) Explain Coefficient of fluctuation of speed and Coefficient of fluctuation of energy. [6]

b) The turning moment diagram for a multi cylinder engine has been drawn to a scale 1mm= 600 N-m vertically and 1 mm = 3° horizontally. The intercepted areas between the output torque curve and the mean resistance line taken in order from one end are as follows;

+52, −124,+92,−140,+85,−72 and +107mm²

Engine is running at 600 rpm. If the total fluctuation of speed is not to exceed ± 1.5% of the mean, find the necessary mass of the flywheel of radius 0.5m. [10]

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Total No. of Pages : 3

Seat No.

T.E. (Mech.) (Part – III) (Semester - V) Examination, May - 2019

HEAT AND MASS TRANSFER

Sub. Code: 66243

Day and Date : Friday, 03 - 05 - 2019 Total Marks : 100

Time : 2.30 p.m. to 5.30 p.m.

Instructions:
1) All questions are compulsory.
2) Figures to the right indicates full marks.
3) Assume suitable data whenever necessary and state it clearly.
4) Use of specific calculators is permitted.

Q1) Solve any three.

a) Define critical radius of insulation. Also derive equation for critical radius of insulation for hollow sphere. [6]

b) Define overall heat transfer coefficient. Also derive the expression of overall heat transfer for a wall having thickness b and conductivity K. Inside and outside heat transfer coefficient as h_i and h_o. [6]

c) A steam pipe of 5cm ID and 6.5cm OD is insulated with 2.75cm thick insulation (K = 1.1W/mK) the inside and outside heat transfer coefficient are 4650W/m²K and 11.5 W/m²K respectively. The K of pipe material is 45W/mK if steam temperature is 200°C and ambient air is 20°C. Determine: [6]
   i) Heat loss per meter length of pipe.
   ii) Interface temperature.

d) A wall of cold storage consist of three layers, and outside layer of bricks 25cm thick, middle layer of cork, 10cm thick and an inner layer of cement 6cm, the K of materials are 0.7, 0.043 and 0.72 W/mK respectively the temperature of outside surface of wall is 30°C and that of inner is -15°C calculate: [6]
   i) Heat transfer per unit area.
   ii) Temperature at interfaces at composite wall.

P.T.O.

Q2) Solve any two.

a) Derive the general heat conduction equation in Cartesian Co-ordinate system. Also write the special cases of this equation. [8]

b) Derive expression for temperature variation for a solid body with respect to time by using lumped heat capacity approach. [8]

c) A long rod of radius 50cm having K = 10W/mK, which generates heat uniformly within the cylinder at the rate of 0.3×10^6 W/m^3. The rod is cooled by convection from it's cylindrical surface at $T_\infty = 50°C$ with h = 60W/m^{2}K. Determine the temperature at the centre and outside surface of cylindrical rod. [8]

Q3) Solve any two.

a) Write short notes on: [8]

i) Explain classification of fins with neat sketch.

ii) Fin efficiency and fin effectiveness.

b) Derive the expression for temperature distribution in a fin of finite length with insulated end. [8]

c) What are the initial and boundary conditions and their types? Explain with suitable examples. [8]

Q4) Solve any two of the following. [16]

a) Explain in detail the phenomenon of natural and forced convection with suitable examples.

b) Define Nusselt number and Reynolds number and prove that they are dimensionless numbers.

c) A liquid metal flows at the rate of 4 kg/s through a constant heat flux 60 mm inner diameter tube in a nuclear reactor. The fluid at 200°C is to be heated with the tube wall 40°C above the fluid temperature. Determine the length of flow tube required for 25°C rise in bulk fluid temperature. Use the correlation, $Nu = 0.023 (Re.Pr)^{0.8}$. Take $\rho = 7.7 \times 10^3$ kg/m^3, $\nu = 8 \times 10^{-8}$ m^2/s, $C_p = 130$ J/kg °C, k = 13 W/m K and Pr = 0.015.

Q5) Solve any two of the following. [16]

a) State Planks law and derive Stefan Boltzmann law from Planks law.

b) Determine the shape factor F_{dA} between small area dA_1 and parallel circular disc A_2. The small area is located at the axis of the disc A_2 at a distance L.

c) Explain the following terms:

i) Intensity of radiation

ii) Lambert cosine rule

iii) Absorptivity

iv) Reflectivity

Q6) Solve any three of the following.

a) Derive an expression for effectiveness of parallel flow heat exchanger. [6]

b) Discuss the advantages of NTU method over LMTD method. [6]

c) Design considerations for heat exchangers. [6]

d) Nusselt's theory of filmwise condensation. [6]

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Total No. of Pages : 4

Seat No.

T.E. (Mechanical) (Part - III) (Semester - V) (Revised) Examination, May - 2019

MACHINE DESIGN - I

Sub. Code : 66244

Day and Date : Monday, 06 - 05 - 2019 Total Marks : 100

Time : 2.30 p.m. to 5.30 p.m.

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Make suitable assumptions wherever required and state them clearly.
4) Use of non - programmable calculator is permitted.
5) Draw neat diagrams wherever necessary.

Q1) Solve any Three: [18]

a) List out steps involved in the design of a machine element. Discuss what is "working drawing".

b) Suggest with justification the suitable material for the following:

i) Ball Bearing

ii) Machine bed

iii) Dairy Equipment

c) Draw neat sketch of a knuckle joint and explain the design procedure.

d) Discuss design of butt weld joint under tension.

Q2) a) Design a turn-buckle to be used for a stay rope subjected to pull of 18 kN. The permissible tensile stress for the steel rods used is 72 MPa. The permissible tensile and shear stress for the cast iron nut used is 56 MPa and 30 MPa respectively. Design the turn-buckle. Refer Table. [8]

P.T.O.

b) The following data is given for the bracket illustrated in fig. 2b. There is no preload in the bolts. The bolts are made of plain carbon steels 45C8 (S_{yt} = 380 N/mm²) and factor of safety is 2.5. Using the maximum shear stress theory, specify the size of the bolts. Refer Table. [8]

P=25 kN e=100 mm l_1 = 150 mm l_2 = 25 mm

Designation	Pitch (mm)	Major or Nominal diameter(mm)	Core diameter(mm)	Tensile Stress Area (mm²)
M10	1.50	10	8.160	58.00
M12	1.75	12	9.858	84.30
M16	2.00	16	13.546	157.00
M20	2.50	20	16.933	245.00
M22	2.5	22	18.933	303
M24	3	24	20.346	353
M27	3	27	23.320	459

OR

b) Figure 2c shows an eccentrically loaded welded joint. Determine the weld size. Allowable shear stress in the weld is 80 MPa.

Q3) a) Discuss design of shaft for rigidity. [6]

b) It is required to transmit a power of 7 kW at 750 rpm. The angular deflection of the steel of the steel spindle transmitting the power should not be more than 0.35° per meter length. The modulus of rigidity for the spindle material is 84 GPa. Determine the diameter of the spindle and the shear stress induced in it. [10]

OR

b) It is required to design a rigid type of flange coupling to connect two shafts. The input shaft transmits 40 kW power at 200 r.p.m. to the output shaft through the coupling. The design torque is 1.5 times the rated torque. Given: Allowable stress for key and shaft is 250 N/mm² in tension and compression, and 80 N/mm² in shear, Allowable stress for flange material 18 N/mm².

Q4) a) What are the various types of springs used in practice? Explain one application of each. [6]

b) Design a helical spring for flat bottom spring loaded safety valve for following working conditions, diameter of valve seat is 65 mm, operating pressure is 0.7 N/mm², maximum pressure when the valve blows off freely is 0.75 N/mm², maximum lift of the valve when the pressure rises from 0.7 N/mm² to 0.75 N/mm² is 3.5 mm, maximum allowable stress is 550 N/mm², modulus of rigidity is 84×10^3 N/mm² and the spring index is 6. [10]

Standard wire gauge (SWG) number and corresponding diameter of spring wire is given in the following table.

SWG	4/0	3/0	2/0	0	1
Diameter (mm)	10.160	9.490	8.839	8.229	7.620

Q5) a) Derive an expression for maximum efficiency for square threaded screw [6]

OR

a) What do you understand by overhauling and self locking of power screw? Hence deduce the condition for self locking screw.

b) Triple start square threaded screw is used to raise the load of 50 kN. A screw has a nominal diameter of 50 mm and a pitch of 8 mm, the height of nut is 40 mm and coefficient of friction between nut and screw is 0.12. There is no collar friction, find maximum shear stress induced in the screw and nut threads also find the bearing pressure between screw and nut. [12]

Q6) a) Explain the step by step procedure for selection of V-belt from Manufacturer's Catalogue. [6]

b) It required to select a flat- belt drive for a fan running at 360 rpm, which is driven by 10 kW, 1440 rpm, motor. The belt drive is open - type and space is available for center distance of 2 m appx. Belt velocity should be between 17.8 to 22.9 m/s. The power transmitting capacity of the belt per mm width per ply 180° arc of contact and at a belt velocity of 5.08 m/s is 0.0116 kW. The load correction factor can be taken as 1.2. Suggest preferred diameters for motor and fan pulleys and give complete specifications of belting.
Refer the tables given below: [10]

The series of preferred values for pitch diameters in mm.

Pitch diameter (mm):	125	132	140	150	160	170	180	190
200	212	224	236	250	265	280	300	315	335	355
400	425	450	475	500	530	560	600	630	670	710
750	800	900	1000							

Arc of Contact Factor (F_θ)

θ (Deg)	130	140	150	160	170	180	190	200
F_θ	1.26	1.19	1.13	1.08	1.04	1.00	0.97	0.94

Standard Widths of these belts in mm

3-Ply	25	40	50	63	76					
4-Ply	40	44	50	63	76	90	106	112	125	152
5-Ply	76	100	112	125	152					
6-Ply	112	125	152	180	200					

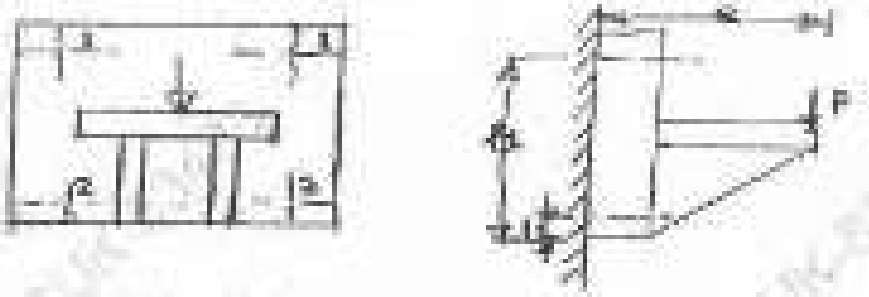

Fig 2.b

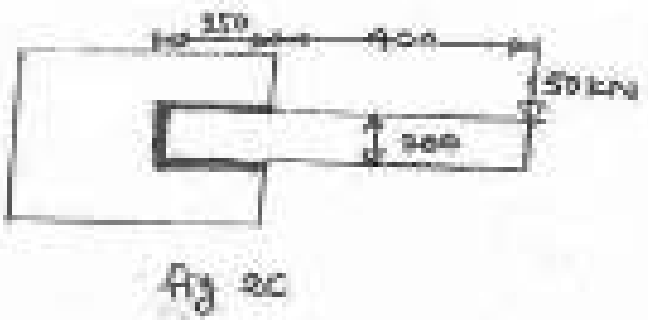

Fig 2.c

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Total No. of Pages : 4

Seat No.	

T.E. (Mechanical) (Part - III) (Semester - V) (Revised) Examination, May - 2019

MANUFACTURING ENGINEERING

Sub. Code : 66245

Day and Date : Wednesday, 08 - 05 - 2019 Total Marks : 100

Time : 2.30 p.m. to 6.30 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume suitable data wherever necessary and state it clearly.
4) Use of non-programmable calculator is allowed.

Q1) Solve any Two.

a) Explain mechanics of chip formation with neat sketch [8]

b) Explain different types of tool material and list important properties of tool material. [8]

c) During machining of C-40 steel with 0-10-6-6-8-90-1mm (ORS) shaped carbide cutting tool, the following observations have been made:

Depth of cut	= 1.5mm
Feed	= 0.15 mm/rev
Speed	= 120 m/min
Tangential cutting force	= 1500 N
Feed thrust force	= 900 N
Chip thickness	= 0.3 mm

Calculate :

Chip thickness ratio, shear angle, shear force and normal force at shear plane, friction force and normal force on tool face and coefficient of friction [8]

P.T.O.

Q2) Solve any Two.

a) Discuss in brief types and selection criteria of cutting fluid. [8]

b) Draw tool geometry of drill and explain nomenclature in detail. [8]

c) The following equation for tool life has been obtained for HSS tool:

$$VT^{0.13} f^{0.38} d^{0.6} = C$$

A 60 mm tool life was obtained using the following cutting conditions:

$$V = 30 \text{ m/min}; f = 0.3 \text{ mm}; d = 2.5 \text{ mm}$$

Calculate the effect on tool life if speed, feed and depth of cut are together increased by 20% and also if they are increased individually by 20%. [8]

Q3) The component shown in Fig. 1 is to be processed on a single spindle automat. Study the component and prepare: [18]

a) Detailed process sheet

b) Tool layout

c) Cam profile for drilling operation

Material : M.S. polish bar ϕ30mm

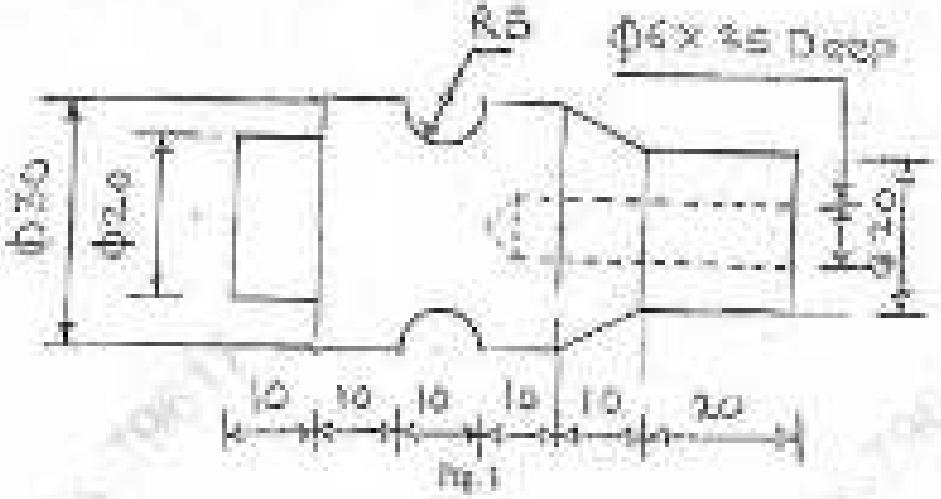

Fig. 1

Q4) Solve any One

a) Design and draw a neat dimensional drawing in three views with one sectional view of a suitable drilling jig for drilling two holes of ϕ 18 mm as shown in Fig. 2. Show clearly the details of location, clamping and guiding of tool. Assume this as a final operation. [26]

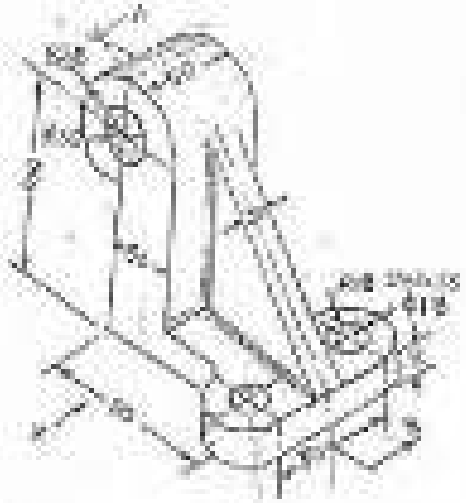

Fig 2

OR

b) Design and draw a dimensional drawing in three views with one sectional view of a milling fixture, for producing the 30 mm wide slot at the component shown in Fig. 3. Show clearly the details of location, clamping and setting of cutter. Assume this as a final operation. [26]

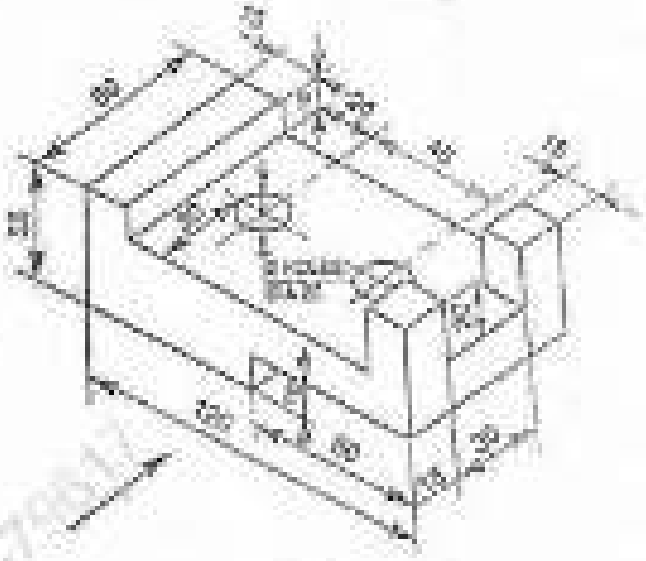

Fig 3

Q5) Solve any two :

a) Explain different methods of reducing cutting forces in press working. [6]

b) Explain strip layout in press working. [6]

c) Estimate the blanking force to cut a blank 35mm wide and 70mm long from a 1.5mm thick metal strip, if the ultimate shear stress of material is 400N/mm^2. Also determine the work done if the percentage penetration is 25 percent of material thickness. [6]

Q6) Write short notes on any Three [12]

a) Automatic tool changer.

b) Milling tooling system.

c) Tool presetting.

d) Construction and working of DNC.

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Seat No.

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Total No. of Pages : 3

T.E. Mechanical (Semester - V) Examination, April - 2018

CONTROL ENGINEERING

Sub. Code : 66241

Day and Date : Tuesday, 24 - 04 - 2018

Time : 10.00 a.m. to 01.00 p.m.

Total Marks : 100

Instructions : 1) All questions are compulsory.

2) Figures to the right indicate full marks.

Q1) a) For the mechanical system shown in figure 1a, construct grounded chair representation and find equation relating f & x. [6]

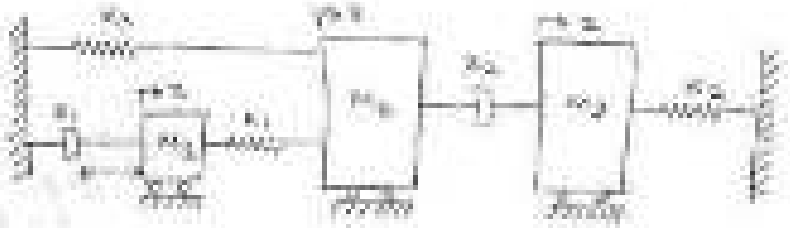

Fig 1. a

b) For the electrical circuit shown in figure 1b, construct mechanical system using direct analog. [6]

Fig. 1. b

c) Obtain mathematical model of rotational system shown in figure 1c. [6]

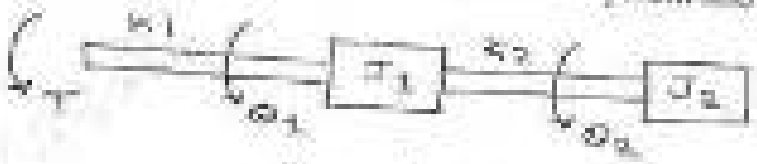

Fig - 1 c

P.T.O

Q2) a) Determine linear approximation for the equation used to find area of right angle triangle. Use this approximation to calculate approximate area when height (H) and base (B) of right angle triangle is 10 units and 5 units respectively. Take $\Delta H = 1.2$ and $\Delta B = 4$. [8]

b) Reduce the block shown in figure 2b and obtain transfer function. [8]

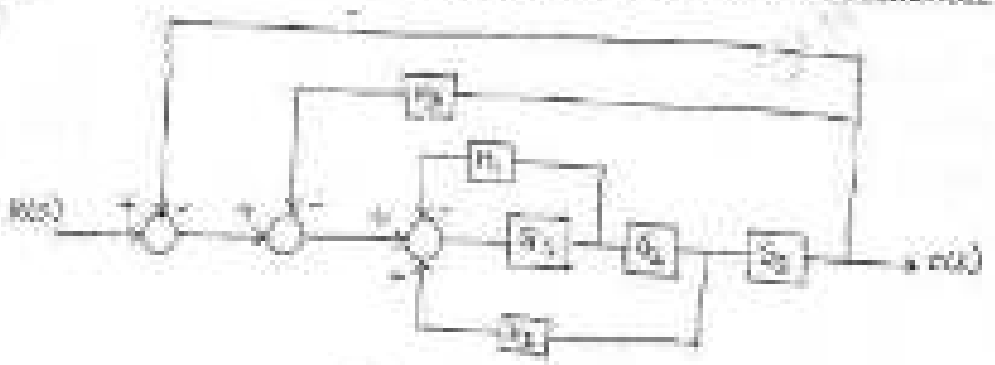

Fig. 2 b

Q3) a) A unity feedback system with an integral controller is shown in figure 3a. Determine response of system when r(t) = u(t) and c(0) = $\dot{c}$ (0) = 0 [8]

Fig. 3 a

b) Figure 3 b shows PD controller. Determine value of Td so that system is critically damped. Calculate its settling time. [8]

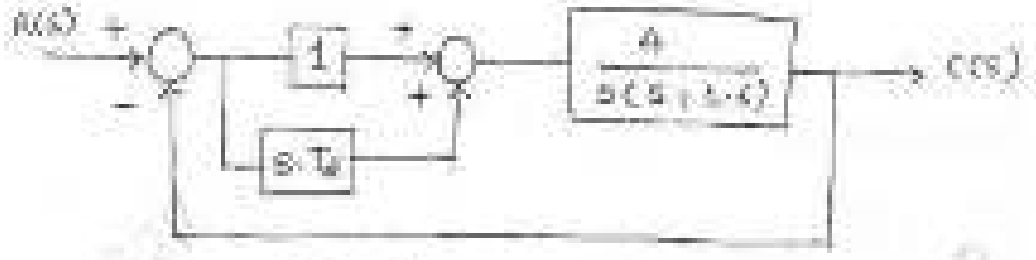

Fig. 3 b

Q4) a) The characteristics equation of a feedback system is $s^4 + 20s^3 + 15s^2 - 2s + k = 0$. Find value of k if [6]

i) System is marginally stable and

ii) System is in stable condition.

b) Obtain root locus for a unity feedback system with open loop transfer function

$$G(s) = \frac{k}{s(s^2 + 6s + 25)}$$

[10]

Q5) a) Determine value of k and ω, so that unity feedback system oscillates at a frequency of 2 rad / sec. The system has open loop transfer function

$$G(s) = \frac{k(s+1)}{s^3 + ks^2 + 2s + 1}$$

[8]

b) Draw Bode plot $G(s) = \frac{100(s+1)}{(s+10)(s+100)}$ [10]

Q6) a) A system is represented by $\frac{y(t)}{r(t)} = \frac{D+4}{D^2+4D+3}$. Construct computer diagram and state space representation using direct programming. [8]

b) Obtain state space representation and computer diagram using parallel programming for the system having transfer function [8]

$$\frac{y(t)}{r(t)} = \frac{D+3}{(D+1)(D+2)(D+3)}$$