**Total No. of Questions : 12]** **[Total No. of Pages : 5**

**P1336**

# [3662]-32
# S.E. (Mech-S/W)
# THERMAL ENGINEERING - I
# (2003 Course) (Sem. - I)

***Time : 3 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates:***

1) ***Answers to the two sections should be written in separate Answer-Books.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of Mollier Charts, Steam Table, and electronic pocket calculator is allowed.***
5) ***Assume suitable data, if necessary.***

## SECTION - I

### Unit - I

***Q1)*** a) For what purpose an Orsat Apparatus is used? Discuss its working with the help of a neat sketch. **[6]**

b) A sample of coal has the following analysis by mass C = 84%; $H_2$ = 5%; incombustible material = 11%. This coal is supplied to a furnace and burnt with 50% excess air that of theoretically required for complete combustion. Estimate the volumetric composition of dry flue gas. **[10]**

OR

***Q2)*** a) Write a short note on alternative fuels for I.C.Engines. **[6]**

b) The fuel supplied to a petrol engine is assumed to have the composition $C_7H_{16}$. Calculate :

i) The stoichiometric air-fuel ratio.

ii) The percentage volumetric composition of the products of combustion if 50% excess air is supplied and combustion is complete.

Assume air contains 21% Oxygen by volume. **[10]**

### Unit - II

***Q3)*** a) Define and explain various steam properties with the help of P-v, T-h and T-s diagram. **[9]**

b) One kg of steam at initial condition of 6 bar and 0.2 dry is heated at constant volume until the pressure is 20 bar. Determine :

i) Final State of Steam.

ii) Heat Added.

iii) Change in Internal Energy. **[9]**

***P.T.O.***

OR

***Q4)*** a) Write a short note on factors affecting on the performance of Rankine Cycle. **[6]**

b) A steam power plant operating on Rankine Cycle generates superheated steam at 10 bar and 380°C. The condensation occurs at 0.06 bar. Calculate :

i) The thermal efficiency of the plan.

ii) The thermal efficiency of Carnot cycle working between the same pressure limits and compare this with Rankine cycle efficiency. **[12]**

## Unit - III

***Q5)*** a) Write a note on Process Boilers and Power Boilers. **[6]**

b) During a boiler trial the following data was obtained : **[10]**

| | | |
|---|---|---|
| Duration of trial | = | 8 hrs |
| Pressure of steam | = | 14 bar |
| Dryness fraction | = | 0.973 |
| Feed water evaporated | = | 26700 kg |
| Temperature of feed water | = | 50°C |
| Coal used | = | 4260 kg |
| Calorific value of coal | = | 28900 kJ/kg |
| Air used per kg of coal | = | 17 kg |
| Temperature of flue gases | = | 344°C |
| Boiler room temperature | = | 21°C |
| $C_p$ of flue gases | = | 1.1 kJ/kg K |

Determine :

i) Boiler efficiency.

ii) Equivalent Evaporation.

iii) Heat lost to flue gases in kJ/kg of coal and in percentage.

OR

***Q6)*** a) Define boiler draught and explain various types of boiler draught. **[6]**

b) A boiler uses 20kg of air per kg of fuel. The fuel consumption is 33kg/sec and actual draught required is 18mm of water taking into account all the losses. Determine the chimney height and its diameter if the actual velocity of flue gases is 0.38 times the theoretical velocity due to friction. The surrounding is at 25°C and flue gas temperature is 230°C. **[10]**

## SECTION - II

### Unit - IV

***Q7)*** a) Give statements of second law of Thermodynamics. **[4]**

b) Explain "Principle of Increase of Entropy". **[4]**

c) A house is to be maintained at a temperature of 20°C by means of a heat pump pumping heat from atmosphere. Heat losses through the walls of the house are estimated at 0.65 kW per unit of temperature difference between inside of the house and atmosphere.

i) If the atmospheric temperature is - 10°C, what is the minimum power required to drive the pump.

ii) It is proposed to use the same heat pump to cool the house in summer. For the same room temperature, the same heat loss rate and the same power input to the pump, what is the maximum permissible atmospheric temperature? **[8]**

OR

***Q8)*** a) Write a note on "Irreversibility". **[4]**

b) Define : **[4]**

i) Available Energy.

ii) Unavailable Energy.

c) Calculate the decrease in available energy when 25kg of water at 95°C mix with 35kg of water at 35°C, the pressure being taken as constant and the temperature of the surroundings being 15°C ($C_p$ of water = 4.2kJ/kg K). **[8]**

### Unit - V

***Q9)*** a) Derive an expression for air standard efficiency of Diesel Cycle. **[8]**

b) In an ideal Otto cycle the air at the beginning of isentropic compression is at 1 bar and 15°C. The compression ratio is 8. If the heat added during the constant volume process is 1000 kJ/kg,
Determine :

i) The maximum temperature in the cycle.

ii) The air standard efficiency.

iii) The work done per kg of air.

iv) The heat rejected.

Take $C_v$ = 0.718 kJ/kg K and $\gamma$ = 1.4. **[8]**

OR

***Q10)*** a) Compare Otto, Diesel and Dual cycle for the same maximum temperature and pressure. **[5]**

b) What are the assumptions made in Fuel-Air Cycle? Discuss the difference between Air Standard and Fuel-Air Cycle by taking an example of Otto cycle. **[6]**

c) Enlist various losses in the actual cycle and explain time losses in detail. **[5]**

## Unit - VI

***Q11)*** a) Enlist different systems of I.C. Engine and explain cooling system. **[6]**

b) A trial was conducted on a single-cylinder oil engine having a cylinder diameter of 30cm and stroke 45cm. The engine is working on the 4-stroke cycle and the following observations were made :

| | | |
|---|---|---|
| Duration of trial | = | 54 minutes |
| Calorific value | = | 42 MJ |
| Gross imep | = | 7.25 bar |
| Net load on the brake | = | 150kg |
| Diameter of the rope | = | 4cm |
| Cooling water temp.rise | = | $48^{o}C$ |
| Sp. Gravity of oil | = | 0.8 |
| Total fuel used | = | 7 litres |
| Total number of revolution | = | 12624 |
| Pumping imep | = | 0.35 bar |
| Diameter of brake drum | = | 1.78m |
| Cooling water circulated | = | 550 litres |
| $C_p$ of water | = | 4.18 kJ/kg K |

Calculate :

i) Mechanical efficiency.

ii) Unaccounted heat losses. **[12]**

OR

***Q12)*** a) Define : **[6]**

i) Indicated and Brake Power.

ii) Brake Thermal Efficiency and Mechanical Efficiency

iii) IMEP and BSFC.

b) During a trial on a 4-cylinder petrol engine running at 50 r.p.s. the brake load was 271 N when all cylinders were working. When each cylinder was cut-out in turn the speed returned to 50 r.p.s. and the brake load reading were 170 N, 188 N, 185 N and 180 N. Using these readings, determine the brake power of the engine and estimate the indicated power and mechanical efficiency. The BP is given by (F.N/455) kW, where F = Brake Load & N = Speed in r.p.s. The following results were also obtained during trial :

| | | |
|---|---|---|
| Total fuel used | = | 0.568 litres in 130 sec. |
| Calorific value | = | 43 MJ |
| Cooling water flow rate | = | 0.29 kg/s |
| Sp. Gravity of oil | = | 0.76 |
| Ambient Temperature | = | $21^{o}C$ |
| Sp. heat of Exhaust gas | = | 1.0015 kJ/kg K |
| A : F ratio | = | 14:1 |
| Cooling water temp.rise | = | $41^{o}C$ |
| Exhaust gas temperature | = | $750^{o}C$ |

Draw up heat balance sheet in kJ/sec and as a % of heat supplied. **[12]**

**Total No. of Questions : 12]** **[Total No. of Pages : 3**

**P1337**

# [3662]-87

## S.E. (Printing Engineering & Graphic Communication)

## MICROPROCESSOR TECHNIQUES AND PERIPHERAL INTERFACE

## (2003 Course)

***Time : 3 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates:***

1) ***Attempt Q. No. 1 or Q.No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6 from section-I and Q. No. 7 or Q. No. 8, Q. No. 9 or Q. No. 10, Q. No. 11 or Q. No. 12 from section-II.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Asssume suitable data, if necessary.***
5) ***Figures to the right indicate full marks.***

### SECTION - I

***Q1)*** a) Draw Pin Diagram of 8085 and explain function of each pin in detail. **[10]**

b) Explain different interrupts with priorities in 8085. **[8]**

OR

***Q2)*** a) What are the different registers available in 8085 microprocessor. Explain in detail the typical use of each register. **[10]**

b) Write short notes on : **[8]**

i) Buses in 8085 microprocessor.
ii) IC74138.

***Q3)*** a) Draw and explain the timing diagram for the instruction MVI A, 90H. **[8]**

b) Describe following instructions in detail. **[8]**

i) LHLD 2500H
ii) DAD B
iii) ANA FOH
iv) CALL 5000H

OR

***Q4)*** a) Explain the sequence of operation when PUSH and POP instructions are executed. **[8]**

b) Draw and explain the Flag Register of 8085. **[8]**

***P.T.O.***

***Q5)*** a) Write a program to subtract a number stored at location 2201H from number stored at location 2301H. Store result at memory location 7500H. (Draw flowchart) **[8]**

b) Write a program to add 87H and 79H. Specify the contents of Accumulator, register B, status of z, s, AC and carry flags. Draw flowchart. **[8]**

OR

***Q6)*** a) Write short notes on : **[8]**

i) Stack and instructions related to stack.
ii) Subroutine, its necessity and functions of CALL & RET instructions.

b) Define addressing modes of 8085 in detail. **[8]**

## SECTION - II

***Q7)*** a) Write a program to generate square wave using DAC. Also draw the interfacing diagram. **[10]**

b) Draw the control word format of 8255 PPI. Explain in brief MODE-2 of 8255 with definition of handshake signals. **[8]**

OR

***Q8)*** a) Draw the format of SIM instruction. Also define maskable and non-maskable interrupts. **[8]**

b) Draw and explain the block diagram of 8259 interrupt controller. State the sequence of events that takes place when an interrupt is recognized by 8259. **[10]**

***Q9)*** a) Draw and explain block diagram of 8251 in detail. Explain its use in any printing application. **[8]**

b) Write short notes on : **[8]**

i) IEEE 488.
ii) RS 232C.

OR

***Q10)*** a) What are the different modes of 8253 Programmable Interval Timer (PIT)? Explain its modes in detail. **[8]**

b) Write short notes on : **[8]**

i) Significance of SOD and SID pins.
ii) Asynchronous and Synchronous Data Transfer.

***Q11)*** a) Explain PLC in detail. State its advantages in Printing Technology. **[8]**

b) Write short notes on : **[8]**

i) Microprocessor-based PID Controller.

ii) Rolling Display using 8085.

OR

***Q12)*** a) State and explain the application of Microprocessors in Printing technology. **[8]**

b) Write short notes on : **[8]**

i) Stepper Motor Control using Microprocessor.

ii) Floppy Disk Controller.

**Total No. of Questions : 12]** **[Total No. of Pages : 4**

**P1173**

# [3662]-35

## S.E. (Mech. S/W)

## FLUID MECHANICS & MACHINERY

### (2003 Course)

***Time : 3 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates :***

1) ***Answer any three questions from each section.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
6) ***Assume suitable data, if necessary.***

## SECTION - I

***Q1)*** a) Define the following terms : **[4]**

i) Mass density.

ii) Dynamic viscosity.

b) Derive expression for : **[6]**

i) Pressure Intensity inside a droplet.

ii) Pressure Intensity inside a hollow bubble.

c) A flat plate of area 0.125 $m^2$ is pulled at 0.25 m/s with respect to another parallel plate 1 mm distant from it. The space between the plates containing water of viscosity 0.001 $NS/m^2$. Find the force necessary to maintain this viscosity, also find power required. **[6]**

OR

***Q2)*** a) Explain the terms : **[6]**

i) Specific mass.

ii) Specific weight.

iii) Specific volume.

b) Draw a sketch of the Bourdon gauge and describe how it is used in the measurement of pressure. **[6]**

***P.T.O.***

c) A capillary tube diameter 1.50 mm is dipped in (i) Water (ii) Mercury. Find the capillary rise for each case. Surface tension for water and mercury may be taken as 0.07 N/M and 0.52 N/M respectively the contact angle will be taken as 0 degree and 130 degree for the two cases respectively. **[4]**

***Q3)*** a) Explain how the metacentric height of a floating body can be determined theoretically and experimentally. **[6]**

b) A uniform cylinder 300 mm in diameter and 150 mm in length floats in mercury of specific gravity 13.6 the depth of immersion of cylinder being 80 mm. Find the metacentric height.

If water is poured now into the vessel over the mercury till the whole of the cylinder is immersed partly in mercury and partly in water, find the depth of immersion in mercury. **[10]**

OR

***Q4)*** a) What are velocity potential and stream functions? Explain. **[6]**

b) Show that the flow is continuous if the velocity components are **[10]** $u = xy$.

$$v = x^2 - \frac{y^2}{2}.$$

***Q5)*** a) Obtain the discharge equation for a venturimeter. **[8]**

b) Water flows up a vertical pipe of diameter 180 mm contracting to a diameter of 120 mm in a height of 0.25 m. If the rate of flow is 80 lit./sec, find the pressure fall across the contraction. Take loss of head due to contraction equal to 0.27 times the kinetic head in the region of smaller diameter of the pipe. **[10]**

OR

***Q6)*** a) State and prove Bernoulli's theorem. State limitations of it. **[8]**

b) Show that for maximum transmission of power the ratio of the outlet area 'a' of the nozzle to the area 'A' of the pipe is given by

$$\frac{A}{a} = \sqrt{\frac{8fl}{D}}.$$ **[10]**

## SECTION - II

***Q7)*** a) Derive an equation for the force exerted by a jet of water on a flat inclined fixed plate. **[5]**

b) A jet of water having a velocity of 20 m/sec strikes a curved vane. Which is moving with a velocity of 10 m/sec. The jet makes an angle of 20° with the direction of motion of vane at inlet and leaves at an angle of 130° to the direction of motion of vane at outlet calculate. **[11]**

i) Vane angles, so that the water enters and leaves the vane without shock.

ii) Work done per second per unit weight of water striking.

OR

***Q8)*** a) i) Give classification of Hydraulic turbines. **[4]**

ii) What is degree of reaction? **[2]**

b) The penstock supplies water from a reservoir to the pelton wheel with a gross head of 500 m. One-third of the gross head is lost in friction in the penstock.

The rate of flow of water through the nozzle fitted at the end of the penstock is 2.0 $m^3$/sec. The angle of deflection of the jet is 165°. Determine the power given by the water to the runner and also hydraulic efficiency of the pelton wheel. Take speed ratio = 0.45 and CV = 1.**[10]**

***Q9)*** a) i) Explain principle of working of centrifugal pump.

ii) NPSH – Explain.

**[8]**

b) A centrifugal pump delivers water and running at 1000 rpm. The outlet vane angle of the impeller is 45° and velocity of flow at outlet is 2.5 m/sec. The discharge through the pump is 200 lit/sec. When the pump is working against a total head of 20 m. If the manometric efficiency of the pump is 80% determine. **[8]**

i) Diameter of impeller,

ii) Width of the impeller.

OR

***Q10)*** a) Write in short about : **[8]**

i) Significance of specific speed.

ii) Air Lift Pump.

b) Write and draw – Characteristic curves of centrifugal pumps & why primary of a centrifugal pump is necessary. **[8]**

***Q11)*** a) Explain with the help of neat sketch principle of working of **[8]**

i) Hydraulic Ram.

ii) Hydraulic Press.

b) The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given.

by $T = D^5 N^2 \rho \phi \left[ \frac{\mu}{D^2 N \rho} \right]$ **[10]**

OR

***Q12)*** Write short notes on : **[8]**

a) i) Hydraulic Accumulator.

ii) Dimensional homogeneity.

b) The pressure difference ΔP in a pipe of diameter D and length *l* due to turbulent flow depends on the velocity V. Viscosity μ, density ρ and roughness K using Buckingham's Π theorem obtain an expression for ΔP. **[10]**

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**Total No. of Questions : 12]** **[Total No. of Pages : 2**

**P1174**

# [3662]-56

## S.E. (Electrical)

## ANALOG & DIGITAL ELECTRONICS

## (203145) (2003 Course)

***Time : 3 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates :***

1) ***Answer 3 questions from Section-I and 3 questions from Section-II.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
4) ***Assume suitable data, if necessary.***

### SECTION - I

***Q1)*** a) Draw and explain working of R-C coupled transistorized amplifier with frequency response. **[10]**

b) Compare BJT and FET as an amplifier. **[6]**

OR

***Q2)*** a) Explain working of Transistorized differential amplifier. **[8]**

b) What is multistage amplifier? What are basic requirements of it? **[8]**

***Q3)*** a) Draw and explain internal block diagram of Op-Amp (IC 741). **[8]**

b) Explain how Op-Amp works as an inverting amplifier? Draw neat waveforms. Also derive gain of the Op-Amp for the same. **[10]**

OR

***Q4)*** a) Explain operation of IC 555 as an Astable Multivibrator. **[8]**

b) Draw a neat circuit diagram of Triangular wave generator using Op-Amp. Also explain its operation with waveforms. **[10]**

***Q5)*** a) With the help of neat diagrams explain different protection circuit used for Voltage Regulators. **[8]**

b) Explain the working of SAR type of Analog to Digital converter. **[8]**

OR

***P.T.O.***

***Q6)*** a) Explain the function of LM 317 as a voltage regulator. **[8]**

b) Explain the working of any one type of Digital to Analog converter. **[8]**

## SECTION - II

***Q7)*** a) Explain the operation of R-S flip flop using NAND gates in detail. **[8]**

b) What are different methods of triggering with clock pulses? **[8]**

OR

***Q8)*** a) Explain the operation of J-K flip flop with truth table in detail. **[10]**

b) Give comparison between sequential and combinational logic circuit. **[6]**

***Q9)*** a) Explain the working of 2 bit (MOD 4) Asynchronous UP Counter with waveforms. **[10]**

b) Explain different data shifting movements in shift resister. **[8]**

OR

***Q10)*** a) Explain the difference between Synchronous and Asynchronous Counter. **[8]**

b) Draw and explain working of 4 bit Twisted ring counter. **[10]**

***Q11)*** a) Explain the operation of 7 segment LED display system in detail. **[8]**

b) Explain the operation of 4 : 1 Multiplexer (MUX) with truth table. **[8]**

OR

***Q12)*** Write short note on : **[16]**

a) Opto-Isolator.

b) LCD display system.

c) Semiconductor Memories.

d) Opto-Encoder.

❐❐❐❐

**Total No. of Questions : 10]** **[Total No. of Pages : 7**

**P1175**

# [3662]-79

## S.E. (Instrumentation & Control)

## NETWORK THEORY

## (2003 Course)

***Time : 3 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates :***

1) ***Answer 3 questions from Section-I and 3 questions from Section-II.***
2) ***Question Nos. 5 and 10 are compulsory. Out of the remaining attempt two questions from Section-I and two questions from Section-II.***
3) ***Answers to the two sections should be written in separate books.***
4) ***Neat diagrams must be drawn wherever necessary.***
5) ***Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
6) ***Assume suitable data, if necessary.***

## SECTION - I

***Q1)*** a) Network shown in Fig. 1 is in steady state with switch closed. At t = 0, switch is opened. Determine voltage across switch ($V_A$) and also find $dV_A/dt$ at $t = 0^+$. **[8]**

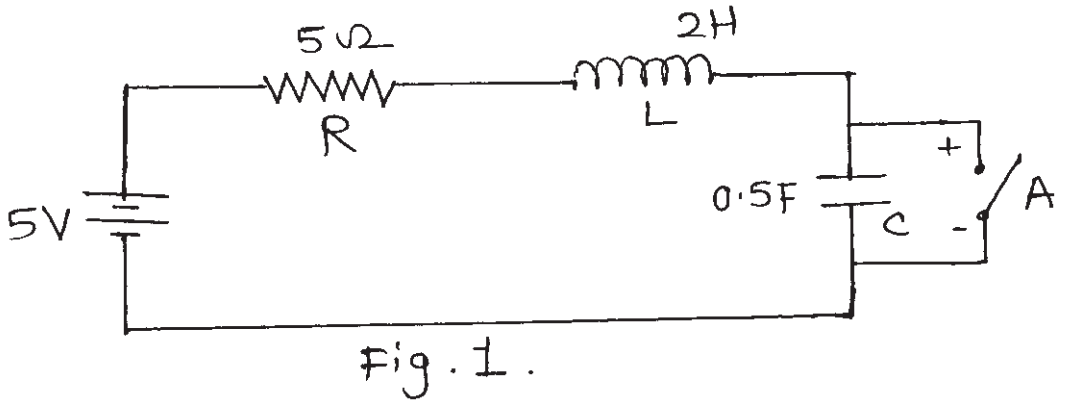



Fig. 1.

***P.T.O.***

b) Calculate the effective resistance between points A & B in the figure 2. **[8]**

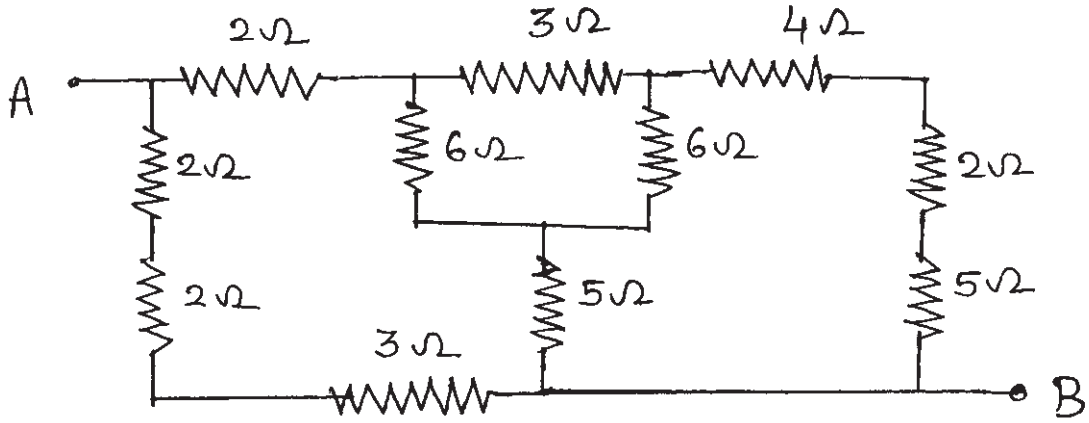



Fig. 2.

OR

***Q2)*** a) Find current through 10 Ω using Cramer's rule and mesh analysis. Shown in Fig. 3. **[8]**

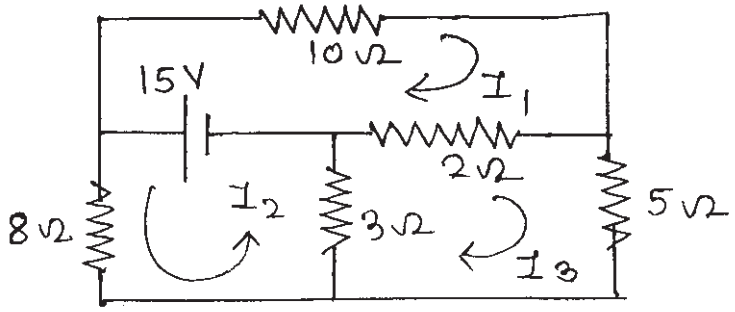



fig. 3

b) For the figure shown in Fig. 4. Write KCL & KVL equation and solve to find currents $I_1$ & $I_2$. **[8]**

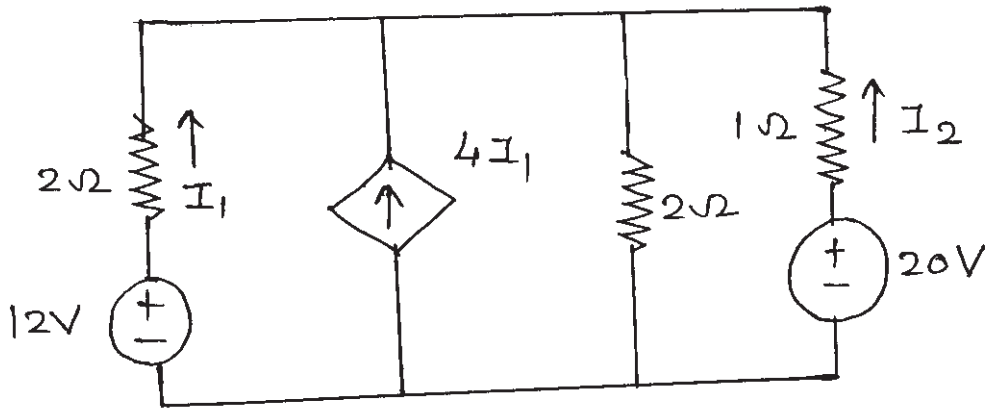



Fig. 4

***Q3)*** a) Consider the driving point impedance $Z(s) = \frac{(s+3)(s+5)}{s(s+4)}$.

Diagnose whether the following impedance represents $R_L$ or $R_C$ Network and find first Cauer form of network. **[8]**

b) Check whether following polynomials are Hurwitz :

i) $s^4 + s^3 + 2s^2 + 4s + 1 = P(s)$ **[4]**

ii) $P(s) = s^3 + 6s^2 + 11s + 6$ **[4]**

OR

***Q4)*** a) Synthesize $Y(s) = \frac{1+4s+3s^2}{1+3s+1.25s^2}$ using Cauer-II form. **[8]**

b) $Y(s) = \frac{(s+2)(s+5)}{s(s+4)(s+6)}$ synthesize using Cauer-I form. **[8]**

***Q5)*** a) Find current through 'R' using Norton's Theorem. Also find the value of $R_L$ such that maximum power transfer takes place from source to 'R' in Network shown in figure 5. **[10]**

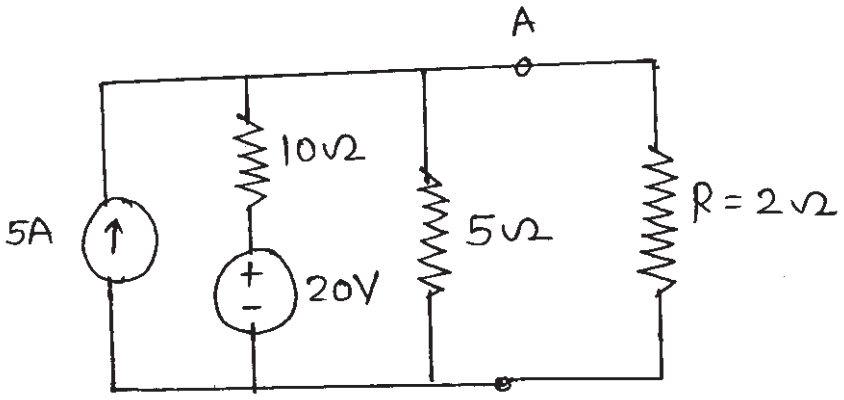



Fig. 5

b) State and prove Tellegens theorem and verify it for Network shown in Fig. 6. **[8]**

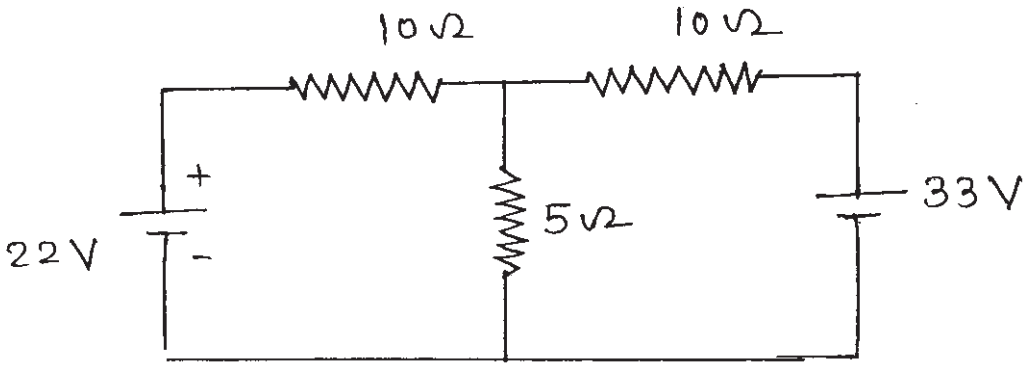



Fig. 6

## SECTION - II

***Q6)*** a) Find the driving point admittance Y(s) for the Network shown in Fig. 7. **[8]**

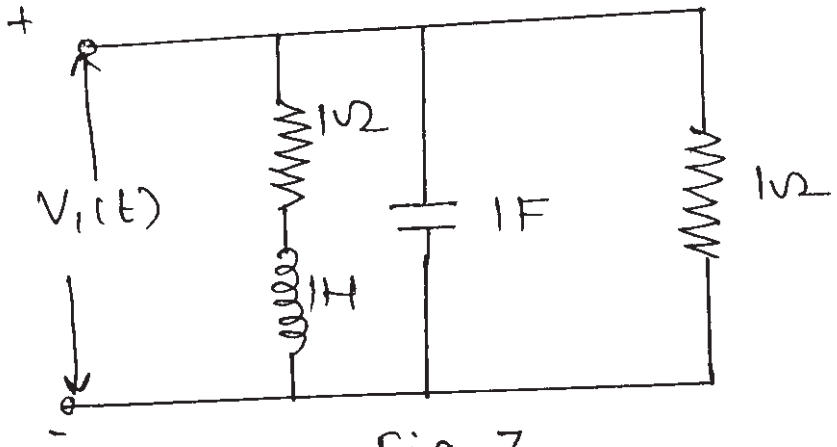



Fig. 7.

b) Obtain the pole zero diagram of given function and obtain the time domain response. **[8]**

$$V(s) = \frac{3s}{(s+2)(s^2+2s+2)}$$

OR

***Q7)*** a) Find the voltage ratio transfer function $G_{21}$ for Network shown in Fig. 8. **[8]**

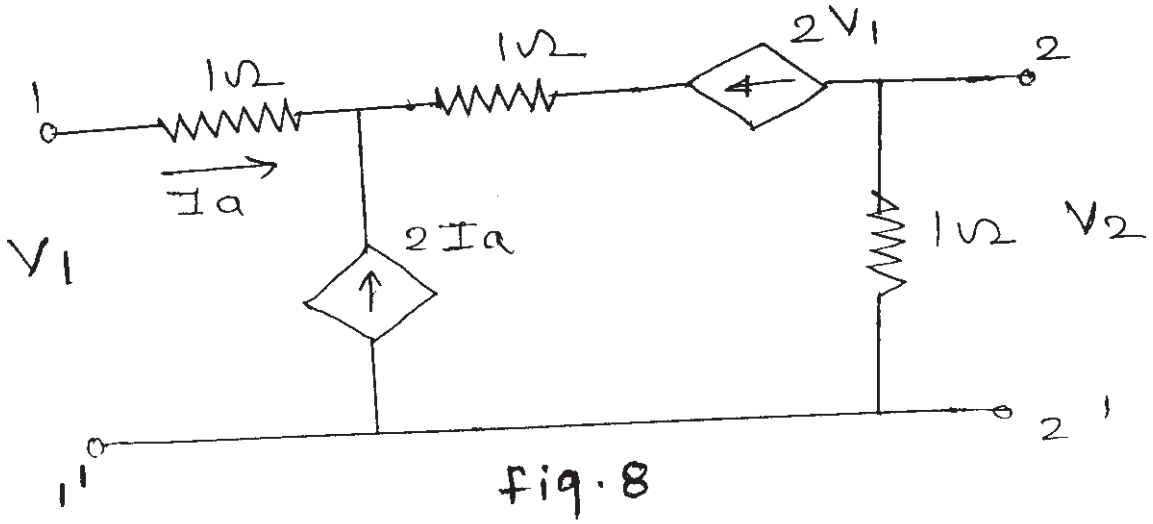



fig. 8

b) A series RLC ckt has driving point admittance pole zero plot as shown in Fig. 9 find R, L, C. **[8]**

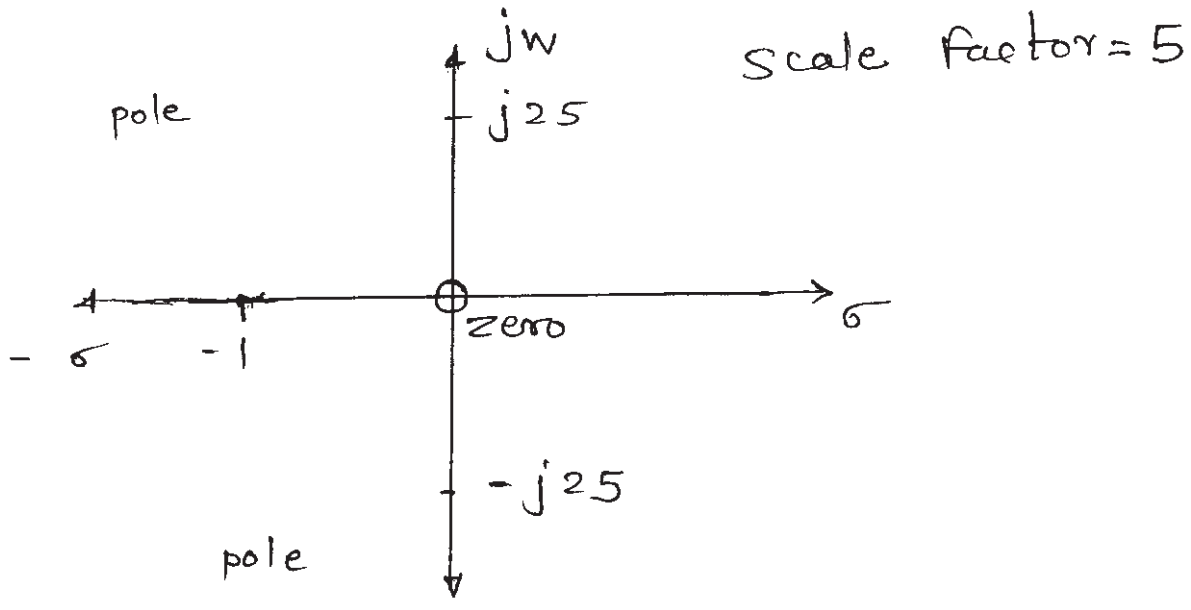



fig. 9

***Q8)*** a) Determine 'Y' and 'Z' parameters for the two port Network shown in Fig. 10. **[8]**

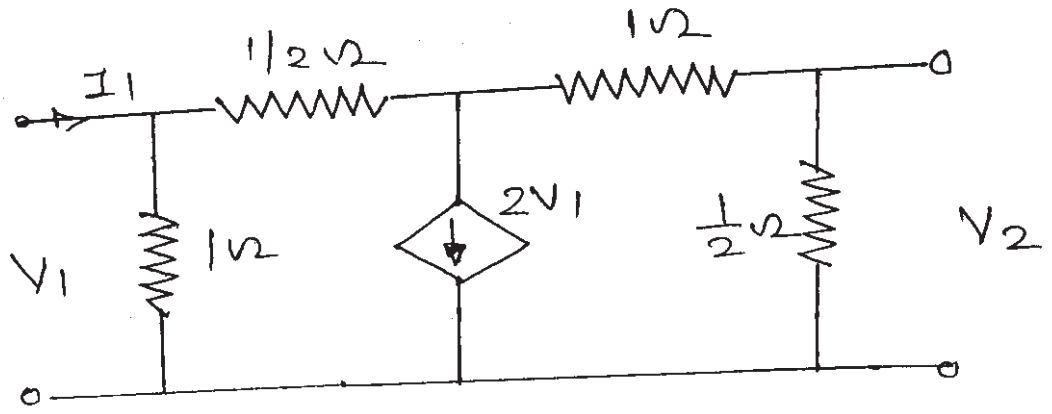



Fig. 10

b) Write short notes on 'Z' and 'Y' parameters.

i) Network diagram. **[2]**

ii) Basic equations. **[2]**

iii) Conditions of symmetry and reciprocity. **[2]**

vi) Relationship between Z and Y parameters. **[2]**

OR

***Q9)*** a) Mention H parameters and draw equivalent network of a two port network interms of h-parameters. **[8]**

b) State the condition for reciprocity and symmetry and also draw the equivalent network for

i) Z parameters. **[4]**

ii) Y parameters. **[4]**

***Q10)*** a) Convert Low pass filter to High pass filter having $\omega_C = 10^6$ rad/s $R_L = 500$ as show in Fig. 11. **[8]**

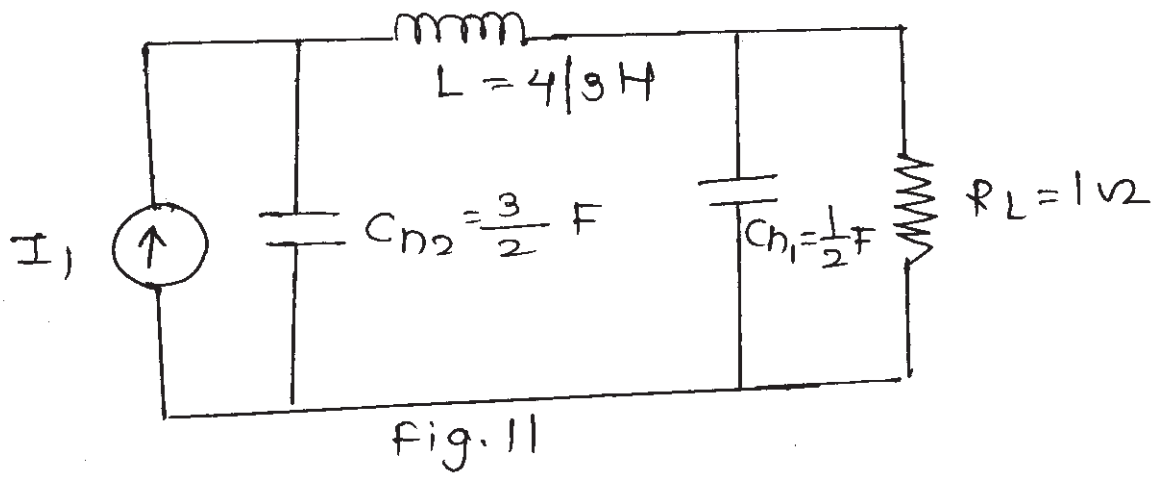


Fig. 11

b) Explain basic types of filters. **[10]**

□□□□

**Total No. of Questions : 12]** **[Total No. of Pages : 4**

**P1176**

# [3662]-88

## S.E. (Printing)

## THEORY OF PRINTING MACHINES

## (2003 Course)

***Time : 4 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates :***

1) ***Answer 3 questions from Section-I and 3 questions from Section-II.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Draw neat diagrams wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Assume suitable data, if necessary.***

### SECTION - I

***Q1)*** a) Distinguish between : **[8]**

i) Mechanism and Machine.

ii) Kinematics and Dynamics.

b) How are kinematic pairs classified? Explain with examples. **[8]**

OR

***Q2)*** a) Describe briefly the functions of elliptical trammel and scotch yoke. **[8]**

b) What are quick-return mechanisms? Discuss the function of any one of them. **[8]**

***Q3)*** a) What is velocity of rubbing? How is it found? **[6]**

b) For the configuration of mechanism shown in Fig. 1. Calculate : **[12]**

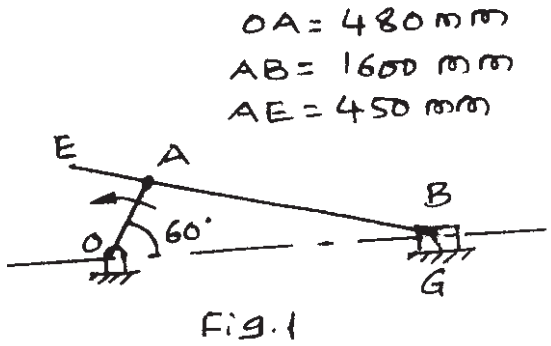



Fig. 1

i) the acceleration of slider at B.

ii) the angular acceleration of link AB.

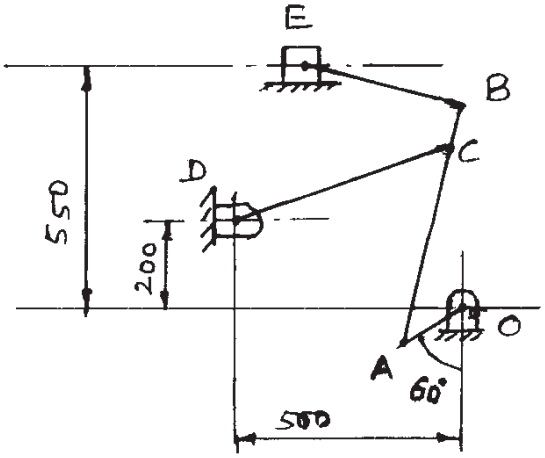
OA rotates at 20 rad/sec counter-clockwise.

***P.T.O.***

OR

***Q4)*** a) Explain velocity image principle. **[6]**

b) Draw the velocity and acceleration diagram for the mechanism shown in Fig. 2. Determine acceleration of ram E. **[12]**




OA = 150
AB = 550
BE = 350
AC = 450
DC = 550
$N_{OA}$ = 150 rpm (counterclockwise)

Fig. 2

***Q5)*** Fig. 3 shows a Crank and slotted lever quick return mechanism. CP rotates at 90 rpm clockwise. Find the velocity and acceleration of E. **[16]**

CP = 105
OD = 420
DE = 165

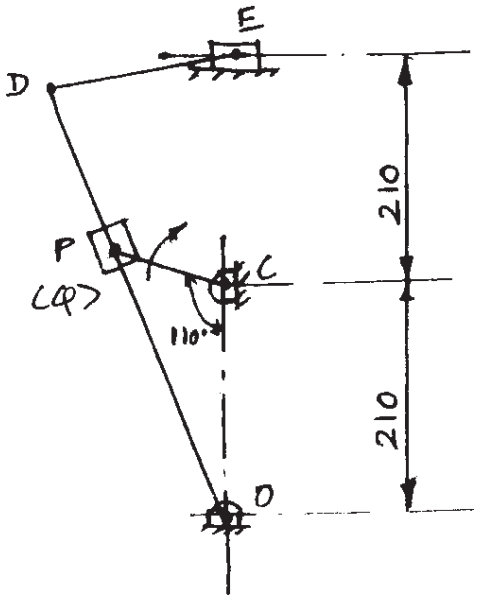



Fig. 3

OR

***Q6)*** Fig. 4 shows an oscillating cylinder mechanism Crank OB rotates at 300 rpm in anticlockwise direction. Determine the angular acceleration of cylinder and acceleration of point A on piston. **[16]**

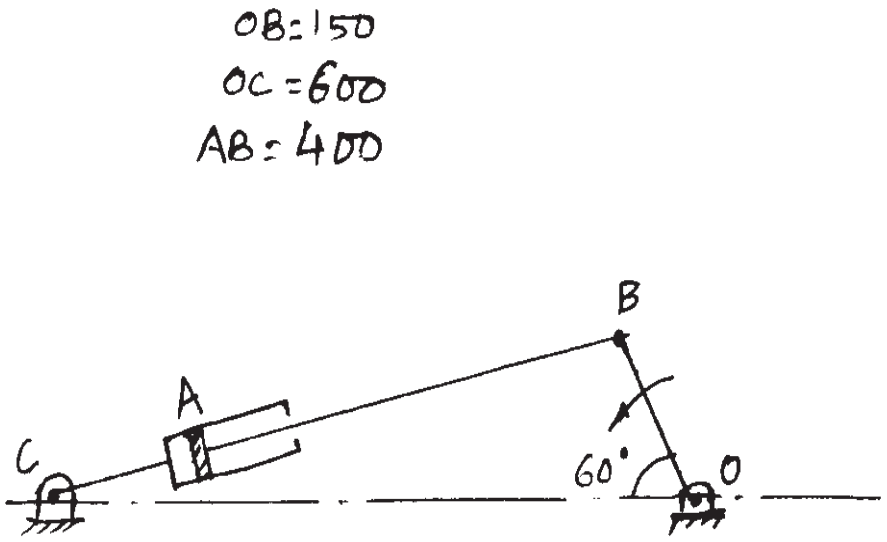



Fig. 4

## SECTION - II

***Q7)*** a) Distinguish between hydrostatic and hydrodynamic lubrication. **[6]**

b) A multiplate clutch is required to transmit 75 kW at 3600 rev/min. The internal diameter of the friction plate surface is 0.8 of the external diameter. The external diameter is 300 mm. The mean allowable pressure should not exceed 0.1 N/mm$^2$. If the coefficient of friction is 0.12, determine the number of plates required. **[10]**

OR

***Q8)*** a) Explain the working of cone clutch with neat sketch. **[8]**

b) A truncated conical pivot bearing supports an axial load of 20000 N from a vertical shaft rotating at 180 rpm has a cone angle of 120°. External radius is 2.5 times the internal radius. Intensity of pressure is not to exceed 36 N/cm$^2$. Find :

i) dimensions of bearing.

ii) power absorbed in friction.

Coefficient of friction is 0.05. **[8]**

***Q9)*** a) Explain any two types of brakes with neat sketches. **[6]**

b) Derive the relation for ratio of tight and slack side tensions for band and block brake. **[8]**

c) What is meant by a self-locking and a self-energized brake? **[2]**

OR

***Q10)*** a) Explain internal expanding shoe brake. **[6]**

b) A differential band brake has a drum of diameter 800 mm. The two ends of the band are fixed to the pins on the opposite sides of the fulcrum of the lever at distances of 40 mm and 200 mm from the fulcrum. The angle of contact is 270° and the coefficient of friction 0.2. Determine the brake torque when a force of 600 N is applied to the lever at a distance of 800 mm from the fulcrum. **[10]**

***Q11)*** a) Derive the condition for transmitting the maximum power in a flat belt drive. **[8]**

b) A rope drive transmits 100 kW at 475 rev/min. by ropes of 25 mm diameter. The rope has a mass of 0.6 kg/m run. The maximum permissible rope tension is 900 N. The groove angle is 45° and the angle of lap is 160°. The coefficient of friction between the rope and the pulley is 0.25.

Find the minimum number of ropes and the pulley diameter. **[10]**

OR

***Q12)*** a) Derive the expression for length of belt in cross belt drive. **[6]**

b) State and explain law of belting. **[4]**

c) Centre distance between two parallel shafts is 5 m. They are connected by an open belt passing over two pulleys 1.6 m and 1 m diameter. The initial tension in the belt is 3 kN. The mass of belt is 1.5 kg/m. The coefficient of friction is 0.3. Calculate the power transmitted when the smaller pulley rotates at 400 rev/min. **[8]**

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**Total No. of Questions : 12]** **[Total No. of Pages : 4**

**P1177**

# [3662]-98
## S.E. (Chemical)
## PRINCIPLES OF DESIGN
## (2003 Course)

***Time : 3 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates :***

1) ***Answers to the two sections should be written in separate answer books.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
4) ***Assume suitable data, if necessary.***

## SECTION - I

***Q1)*** a) What do you understand by degree of freedom? What is its importance in process equipment design? **[5]**

b) What do you understand by standards in design? Explain in short how these standards are used in design. **[6]**

c) With neat flow sheet explain procedure of machine design. **[6]**

OR

***Q2)*** a) What do you understand by the term "factor of safety"? Explain various values of factor of safety in process equipment design. **[6]**

b) The diameter of a piston of the steam engine is 300 mm and the maximum steam pressure is 0.7 N/mm$^2$. If the maximum permissible compressive stress for the piston rod material is 40 N/mm$^2$, find the size of the piston rod. **[6]**

c) Explain codes and their significance in chemical process equipment design. **[5]**

***Q3)*** a) Draw SFD and BMD for the beam with loading as shown in figure 1. **[8]**

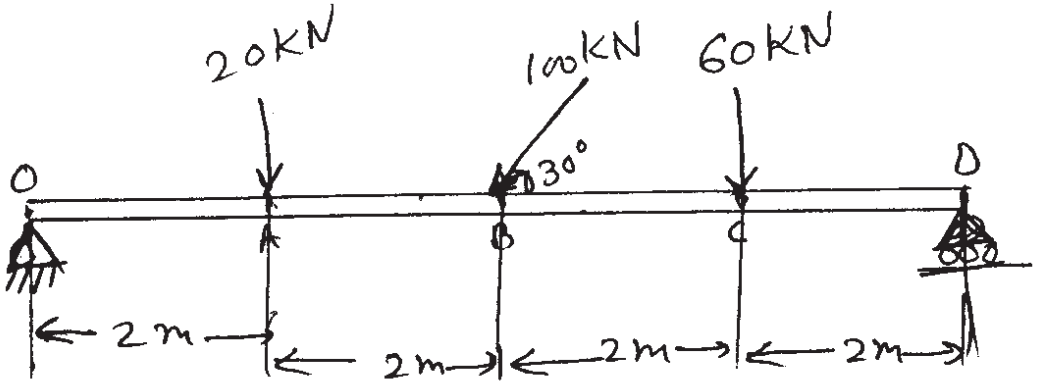


Figure 1

***P.T.O.***

b) Draw SFD and BMD for the beam with loading as shown in figure 2. **[9]**

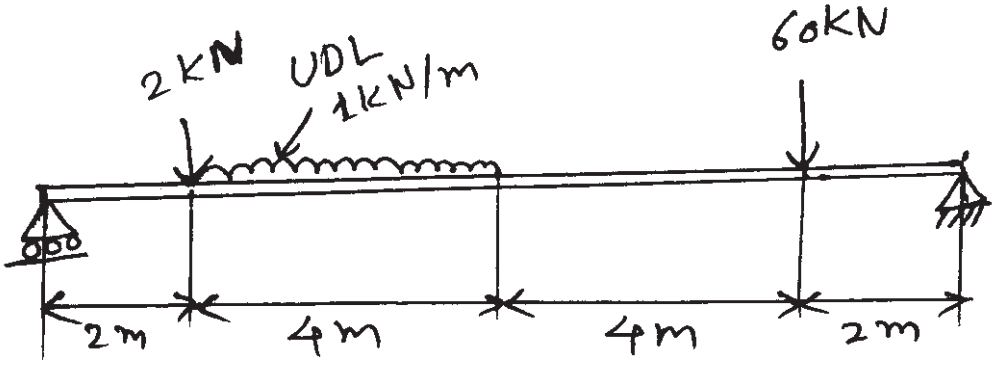


Figure 2

OR

***Q4)*** a) Draw SFD and BMD for the following beam as in figure 3. **[9]**

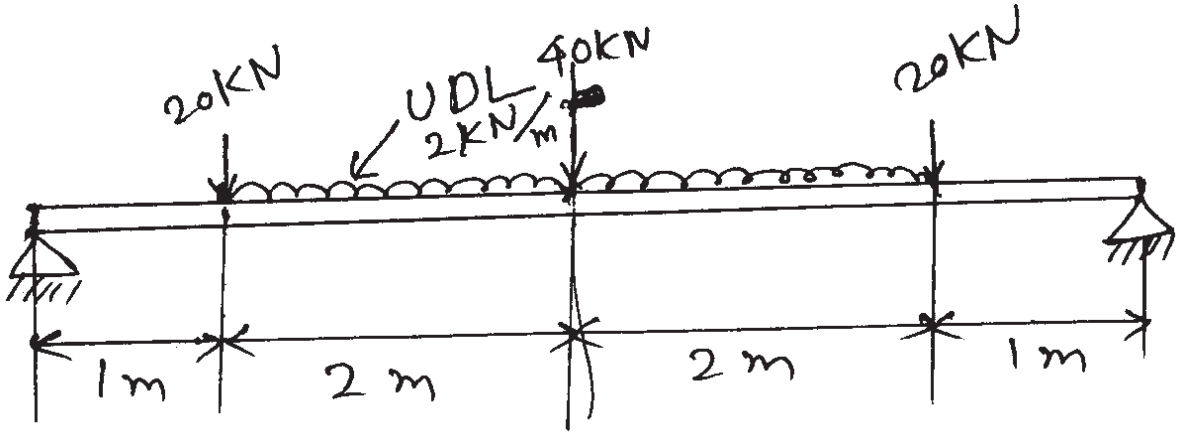


Figure 3

b) Draw SFD and BMD for the following beam as in figure 4. **[8]**

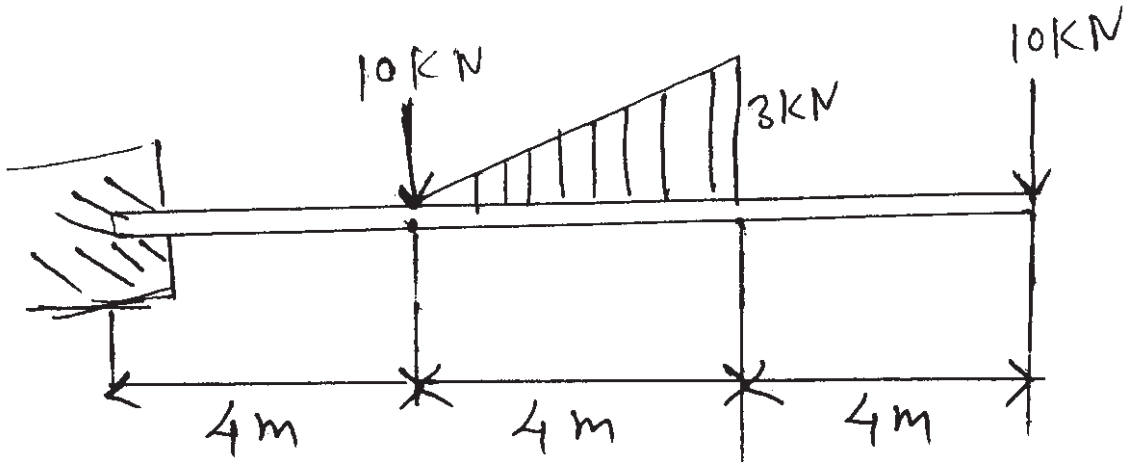


Figure 4

***Q5)*** Two plates of 10 mm thickness each are to be joined by means of a single riveted double strap butt joint. Determine the rivet diameter, rivet pitch, strap thickness and efficiency of the joint. Take the working stresses in tension and shearing as 80 MPa and 60 MPa respectively. **[16]**

OR

***Q6)*** a) Determine the length of the weld run for a plate of size 120 mm wide and 15 mm thick to be welded to another plate by means of

i) A single transverse weld; and

ii) Double parallel fillet welds when the joint is subjected to variable loads. Assume the tensile stress as 70 MPa and shear stress as 56 MPa for static loading. The permissible tensile stress $\sigma_t = 46.7$ N/mm$^2$ and permissible shear stress $\tau = 20.74$ N/mm$^2$. **[10]**

b) In case of screwed joint define the following terms : **[6]**

i) Major diameter ii) Minor diameter

iii) Pitch and iv) Lead.

## SECTION - II

***Q7)*** a) It is required to design a square key for fixing a gear on a shaft of 25 mm diameter 15 kW power at 720 rpm is transmitted from the shaft to the gear. The key is made of steel 50 C4 ($S_{yt} = 460$ N/mm$^2$) and the factor of safety is 3. The yield strength in compression can be assumed to be equal to the yield strength in tension. Determine the dimensions of the key. **[8]**

b) A shaft made of mild steel is required to transmit 100 kW at 300 r.p.m. The supported length of the shaft is 3 metres. It carries two pulleys each weighing 1500 N supported at a distance of 1 metre from the ends respectively. Assuming the safe value of stress, determine the diameter of the shaft. Take $\tau = 60$ N/mm$^2$. **[8]**

OR

***Q8)*** a) A rigid coupling is used to transmit 50 kW power at 300 r.p.m. There are six bolts. The outer diameter of flanges is 200 mm, while the recess diameter is 150 mm. The coefficient of friction between the flanges is 0.15. The bolts are made of 45C8 steel ($S_{yt} = 380$ N/mm$^2$) and the factor of safety is 3. Determine the diameter of the bolts. Assume that the bolts are set in large clearance holes. **[8]**

b) A hollow shaft is subjected to a maximum torque of 1.5 kN.m and a maximum bending moment of 3 kN.m. It is subjected, at the same time to an axial load of 10 kN. Assume that the load is applied gradually and the ratio of the inner diameter to the outer diameter is 0.5. If the outer diameter of the shaft is 80 mm, find the shear stress induced in the shaft. **[8]**

***Q9)*** a) On what factors did the selection of belt drive depends? **[4]**

b) Explain various types of belt drives and types of belts. **[6]**

c) Write short note on : **[8]**

i) Slip of the belt and

ii) Creep of belt.

OR

***Q10)*** a) Write short note on rolling contact bearings. **[5]**

b) Explain sliding contact bearings. **[5]**

c) A belt 100 mm wide and 10 mm thick is transmitting power at 1000 meters/min. The net driving tension is 1.8 times the tension on the slack side. If the safe permissible stress on the belt section is 1.6 MPa. Calculate the maximum power that can be transmitted at this speed. Assume density of the leather as 1000 kg/$m^3$. Calculate the absolute maximum power that can be transmitted by this belt and the speed at which this can be transmitted. **[8]**

***Q11)*** a) With neat sketches explain different types of valves used in the industries. **[8]**

b) With neat sketch explain working of centrifugal pumps. **[8]**

OR

***Q12)*** a) With neat sketch explain different types of steam traps. **[8]**

b) With neat sketch explain working of receprocating pumps. **[8]**

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**Total No. of Questions : 12]** **[Total No. of Pages : 3**

**P1178**

# [3662]-100

## S.E. (Chemical)

## MECHANICAL OPERATIONS

## (2003 Course)

***Time : 3 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates :***

1) ***Answer three questions from Section-I and three questions from Section-II.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Assume suitable data, if necessary.***

### SECTION - I

***Q1)*** a) Explain the need of size reduction in process industries. **[4]**

b) Differentiate differential and cumulative analysis with proper examples. **[6]**

c) What is the power required to crush 90 ton/h of limestone if 80 percent of the feed passes a 2 in. screen and 80 percent of the product a 1/8 in. screen.
Work index for limestone = 12.74 **[8]**

OR

***Q2)*** a) Explain the working of the following with neat sketches. **[8]**
i) Grizzly screens.
ii) Trommel.

b) What are the factors influencing the size of the product in a ball mill? **[4]**

c) If the crushing rolls, 1 m in diameter, are set so that the crushing surfaces are 12.5 mm apart and angle of nip is 31°, what is the maximum size of particle which should be fed to the rolls?

If the actual capacity of the machine is 12 percent of the theoretical, calculate the throughput in kg/s when running at 2.0 Hz if the working face of the rolls is 0.4 m long and the bulk density of the feed is 2500 $kg/m^3$. **[6]**

***Q3)*** a) List different methods and equipments used in transportation of solids. Briefly discuss pneumatic conveying method and its advantages and disadvantages. **[10]**

***P.T.O.***

b) What are the factors to be considered in the selection of a conveyor system? **[6]**

OR

***Q4)*** a) Describe the working of belt conveyor with suitable sketches. List advantages and disadvantages of belt conveyors and typical applications. **[8]**

b) Describe with a sketch the working of a screw conveyor. List advantages, disadvantages and typical applications. **[8]**

***Q5)*** a) Describe briefly any one of the mixer for paste and plastic masses. **[8]**

b) Derive the relation $N_P = K (N_{Re} \cdot N_{Pr})$ for power requirement in fluid mixing with the help of dimensional analysis method. Explain physical significance of the dimensionless numbers involved in this equation. **[8]**

OR

***Q6)*** a) Explain the purpose of agitation. **[4]**

b) A slity soil containing 14 percent moisture was mixed in a large Muller mixer with 10.00 weight percent of a tracer consisting of dextrose and picric acid. After 3 min. of mixing 12 random samples were taken from the mix and analyzed colorimetrically for tracer material. The measured concentrations in the sample were in weight percent tracer, 10.24, 9.30, 7.94, 10.24, 11.08, 10.03, 11.91, 9.72, 9.20, 10.76, 10.97, 10.55. Calculate the mixing index $I_p$ and the standard deviation S. **[8]**

c) Write a short note on rate of mixing. **[4]**

## SECTION - II

***Q7)*** a) A plate and frame press, filtering a slurry, gave a total of 8 $m^3$ of filtrate in 1800 seconds and 11 $m^3$ in 3600 seconds, when filtration was stopped. Estimate the washing time in seconds if 3 $m^3$ of wash water was used. The resistance of the cloth can be neglected and a constant pressure is used throughout. **[8]**

b) What are filter aids? How do they function? Describe their applications. **[8]**

OR

***Q8)*** a) What are the various factors which affect the rate of filtration? Derive an expression to calculate the rate of filtration. **[12]**

b) Explain vacuum leaf filter in detail. **[4]**

***Q9)*** a) Describe aggregative and particulate fluidization. If fine catalyst particles are fluidized in water, then which type of fluidization would be observed. **[8]**

b) Describe with a neat sketch the sedimentation operation. Also sketch typical commercial equipment. **[8]**

OR

***Q10)*** a) Explain the sink and float method and differential settling method in sorting classifiers. **[8]**

b) What is minimum fluidization and derive an expression for it? **[8]**

***Q11)*** a) Write a short note on froth floatation cell. **[8]**

b) Explain construction and working of : **[10]**

i) Cyclone separator.

ii) Magnetic separator.

OR

***Q12)*** Write short notes on : **[18]**

a) Mineral jig.

b) Hydrocyclones.

c) Scrubbers.

d) Fabric filters.

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**Total No. of Questions : 12]** **[Total No. of Pages : 4**

**P1179**

# [3662]-256

## S.E. (Petroleum/Petro-chemical/Polymer)

## SOLID HANDLING OPERATION

## (2003 Course)

***Time : 3 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates :***

1) ***Answer Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6 from Section - I and Q. No. 7 or Q. No. 8, Q. No. 9 or Q. No. 10, Q. No. 11 or Q. No. 12 from Section - II.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Assume suitable data, if necessary.***
5) ***Use of logarithmic table, slide rule and electronic pocket calculator is allowed.***

### SECTION - I

***Q1)*** a) Describe with neat sketch screen analysis methods. Explain why cumulative analysis is more precious than differential analysis. **[8]**

b) Define sphericity. Write significance of sphericity with respect to particle shape. **[4]**

c) Calculate the sphericity of cylinder of diameter 1 cm & height 3 cm. **[6]**

OR

***Q2)*** a) List the various methods for storage of solid & discuss them in brief. **[4]**

b) Write the short note on Angle of repose & Angle of friction. What is its importance in case of storage of solid? **[6]**

c) A large welded steel silo 12 feet in diameter and 60 feet high is to be built. The silo has a central discharge on a flat bottom. Estimate the pressure of wall at the bottom of silo, if silo is filled with

i) Plastic pellets

ii) Water

$\gamma = 35$ lb/cu ft., $\theta = 20°$ **[8]**

***P.T.O.***

*Q3)* a) Explain with neat sketch working & principle of Electrostatic Separator. **[6]**

b) What is forth floatation process? Explain process with respect to following points. **[8]**

i) Promoter ii) Collector

iii) Modifier iv) Application in chemical Engg.

c) What is principle of magnetic separator? **[2]**

OR

*Q4)* a) Discuss with neat sketch working & principle of Hydraulic jig. **[8]**

b) Differentiate between gravity settler & centrifugal settler. **[4]**

c) Write short note on "liquid washing". **[4]**

*Q5)* a) A certain crusher takes rock whose average particle diameter is 0.025 m and crushes it to a product whose average particle diameter is 0.018 m, at the rate of 20,000 Kg/hr. At this rate, mill takes 684 (Kgf) m/sec. of power & (35 Kgf) m/sec. power is required to run it empty. **[8]**

i) What would be the power consumption for same capacity, if the average particle diameter in product is 0.008 meter.

ii) How much powder would be required under condition (i) by Kick's law?

b) What should be the diameter of set of rolls to take feed of size equivalent to 38 mm spheres and crush to 12.7 mm.
Coefficient of friction = 0.35. **[6]**

c) What is work index? **[2]**

OR

*Q6)* a) A certain set of crushing rolls has rolls of 150 cm in diameter by 50 cm width of face. They are set such that the crushing surfaces are 1.25 cm apart at the narrowest point. The manufacture recommended 100 rpm, as the roll speed. They are to crush a rock having a specific gravity of 2.35 and the angle of nip is 30°. **[8]**

i) What are permissible size of feed and the maximum actual capacity in metric tones per hour if actual capacity is 12% of theoretical capacity?

ii) After long use the tires on the roll of mill have become roughed so that the angle of nip is 32° 30′. What will now be the maximum permissible size of feed and the capacity of rolls?

b) In a ball mill of diameter 2000 mm, 100 mm diameter steel balls are being used for grinding. Presently, for the material being ground, the mill is run at rpm 15 rpm. At what speed will the mill have to be run if the 100 mm balls are replaced by 50 mm ball, all the other condition remaining the same. **[6]**

c) What is size enlargement? **[2]**

## SECTION - II

***Q7)*** a) Derive expression for drag & lift forces exerted by flowing fluid on stationary body. **[10]**

b) Explain kynch theory of sedimentation **[6]**

OR

***Q8)*** a) Calculate terminal falling velocity of steel ball 2 mm diameter (density 7870 $Kg/m^3$, viscosity 50 m $Ns/m^2$). **[4]**

b) What is flocculation? Discuss flocculation in detail. **[6]**

c) Write applications of thickener? Discuss design of thickener in brief. **[6]**

***Q9)*** a) Derive equation for minimum fluidization velocity for fluidized bed. **[8]**

b) List the application of fluidization & explain any two in detail. **[8]**

OR

***Q10)*** a) Explain in detail effect of fluid velocity on pressure gradient & pressure drop on in fluidized bed. **[8]**

b) Write short note on "spouted fluidized bed". **[4]**

c) Estimate bed pressure drop expressed in cm of water (manometer) for particles (density = 2000 $kg/m^3$ Dp = 0.05 cm) of 60 cm bed depth and bed porosity of 0.5. **[4]**

***Q11)*** a) Explain with neat sketch rotary drum filter in detail. **[8]**

b) Differentiate between filter & membrane used for separation of solid liquid separation. **[4]**

c) A sludge forming a uniform non-compressible cake is filtered through a filter press out of which one frame is kept under study. At a constant pressure difference of 2.8 kg/cm$^2$, a 10 cm cake is formed in one hour with a filtrate volume of 6000 liter.

Three minute are needed to drain liquor from filter. Two minutes are needed to fill the filter with water. Washing proceeds exactly as filtration using 1200 liter. Opening, dumping and closing take 6 minutes. Assume the filtrate has the same properties of wash water and neglect the resistances offered by cloth and flow lines. How many liters of filtrate are produced in 24 hours on average? **[6]**

OR

***Q12)*** a) Explain reverse osmosis process with neat sketch. **[8]**

b) Write short note on delayed cake filtration. **[4]**

c) A leaf filtering slurry, gave a total of 8 m$^3$ filtrate in 30 minutes. Filtration was continued till 11.3 m$^3$ of filtrate was collected. Estimate the washing time in minute, if 11.3 m$^3$ of wash water are used. The resistances of the cloth can be neglected & a constant pressure is used throughout. **[6]**

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**Total No. of Questions : 12]** **[Total No. of Pages : 4**

**P1180** **[3662]-257**

# S.E. (Petroleum/Petrochemical/Polymer Engineering)

# HEAT TRANSFER

## (212389) (2003 Course)

***Time : 3 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates :***

1) ***Answers to the two sections should be written in separate answer books.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Assume suitable data, if necessary.***
5) ***Use of logarithmic table, electronic pocket calculator is allowed.***

## SECTION - I

***Q1)*** a) Define heat transfer and discuss with one example the importance of heat transfer. **[4]**

b) Explain with the importance the following terms: **[8]**
Temperature, Heat, Conduction, Convection, Radiation.

c) Explain in detail the term "Thermal Conductivity". **[4]**

OR

***Q2)*** a) Explain with one example the term "Thermal Resistance". **[8]**

b) Write a short note on Heat transfer via convection. **[4]**

c) Calculate the rate of the heat transfer per unit area through a copper plate 45 mm thick whose one face is maintained at 350°C and other face at 50°C. Thermal Conductivity $k_{(Copper)}$ = 370 w/m °C. **[4]**

***Q3)*** a) Describe an expression for the heat transfer via conduction. **[8]**

i) Through a plane wall with thickness L and thermal conductivity K and

ii) Through the composite wall made up of Layer A, B and C with $K_A$, $K_B$ and $K_C$ as thermal conductivity of Layer A, B and C and $L_A$, $L_B$ and $L_C$ as respective lengths of Layer A, B and C.

***P.T.O.***

b) Derive the necessary expression for the heat conduction through a hollow cylinder under the following cases: **[8]**

i) Uniform thermal conductivity K and

ii) Variable thermal conductivity given by the equation $K = K_0(1 + \beta T)$.

OR

***Q4)*** a) Explain with the necessary expression the term "Logarithmic mean area for the hollow cylinder." **[8]**

b) A reactor wall which is composed of 220 mm of Fire Brick, 150 mm of Common Brick, 50 mm of Magnesia. If the inside wall surface temperature is at 1500°C and outside surface temperature is at 90°C. Estimate the temperature between the layers and find the rate of the heat loss per unit area.

Thermal conductivity $k_{\text{Fire Brick}}$ = 1.11 w/m°C

Thermal conductivity $k_{\text{Common Brick}}$ = 0.78 w/m°C

Thermal conductivity $k_{\text{Magnesia}}$ = 0.067 w/m°C **[8]**

***Q5)*** a) Explain the following Dimensionless Numbers with their importance. **[10]**

i) Reynolds Number ii) Prandtl Number

iii) Nusselt Number iv) Rayleigh Number

v) Grashof Number

b) Elaborate on Dittus-Boelter Equation. **[8]**

OR

***Q6)*** a) Write a note on Thermal Boundary Layer. **[6]**

b) Air at one atmosphere pressure, 40°C flows with a velocity 5 m/sec over a 2 m long flat plate whose surface is kept at a uniform temperature of 120°C. Determine the average heat transfer coefficient over the 2 m length of the plate and also find out the rate of heat transfer between plate and air per 1 m width of the plate.

Properties of Air at given one atmosphere pressure and mean bulk temperature are as below:

$k = 0.03025$ w/m°C, $N_{Pr} = 0.6965$,

kinematic viscosity $\nu = 2.107 \times 10^{-5}$ $m^2$/sec.

Average Nusselt Number is given by :

$(N_{Nu})_{Avg} = 0.664 \times (N_{Re})^{1/2} \times (N_{Pr})^{1/3}$ **[10]**

c) Define Stanton Number. **[2]**

## SECTION - II

***Q7)*** Explain the following terms: **[16]**

a) Total Emissive power of a black body.

b) Emission from real body surface.

c) Absorptivity.

d) Reflectivity.

e) Transmissivity.

f) Opaque Body.

g) White Body.

h) Gray Body.

OR

***Q8)*** a) A steel plate with thermal conductivity 45 w/m°C and dimensions of the plate are (600 mm × 900 mm × 25 mm) is maintained at 310°C. Air at 15°C blows over the plate. If the convective heat transfer coefficient is 22 w/$m^2$ °C and 250 watt is lost from the plate surface by radiation. Find the inside plate temperature. **[10]**

b) Discuss in detail Kirchhoff's law. **[6]**

***Q9)*** a) Define heat exchanger and discuss in brief the classification of the heat exchangers. **[10]**

b) Explain the term Overall Heat Transfer Coefficient. **[6]**

OR

***Q10)*** a) Define the term "Logarithmic Mean Temperature Difference".
It is desired to heat 4450 kg/h of cold benzene from 27°C to 49°C by using hot toluene which is cooled from 71°C to 38°C. Benzene flows through the inner pipe in counter current manner to toluene. Find the log mean temperature difference for the given case. **[6]**

b) The following data relate for the parallel flow heat exchanger in which air is heated by hot exhaust gases.
Heat transferred per hour Q = 155450 kJ/h.
Inside heat transfer coefficient = 120 w/$m^2$°C.
Outside heat transfer coefficient = 195 w/$m^2$°C.
Inlet and outlet temperature of hot fluid = 450°C and 250°C.
Inlet and outlet temperature of cold fluid = 60°C and 120°C.
Inner diameter and outer diameter of the tube = 50 mm and 60 mm respectively.
Find the length of the tube required for the necessary heat transfer to occur. Neglect the tube wall thermal resistance. **[10]**

***Q11)*** a) Define Evaporation with it's the importance and state the classification of evaporators. **[6]**

b) Discuss the following terms : **[12]**

i) Evaporator Capacity,

ii) Evaporator Economy,

iii) Boiling point elevation,

iv) Material and enthalpy balances for single effect evaporator.

OR

***Q12)*** Discuss in detail with neat diagrams the following : **[18]**

a) Short tube evaporator.

b) Long tube vertical evaporator.

❐❐❐❐

**Total No. of Questions : 12]** **[Total No. of Pages : 6**

**P1199**

# [3662]-258

## S.E. (Petrochemical/Petroleum/Polymer)

## PROCESS CALCULATIONS

## (2003 Course)

***Time : 3 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates :***

1) ***Attempt Q 1 or Q 2, Q 3 or Q 4, Q 5 or Q 6, Q 7 or Q 8, Q 9 or Q 10, Q 11 or Q 12.***
2) ***Answers to the two sections to be written in separate answer books.***
3) ***Figures to the right indicate full marks.***
4) ***Use of electronic calculators, steam table is allowed.***
5) ***Draw neat sketch wherever necessary.***

## SECTION - I

***Q1)*** a) 1000 $m^3$ of a mixture of $H_2$, $N_2$ and $CO_2$ at 150°C was found to have the following ratio of the partial pressures of the gases :

$$P_{H_2} : P_{N_2} : P_{CO_2} = 1:4:3 .$$ **[8]**

If the total pressure is 2 atm, absolute, find

i) mole fraction of each of these gases.

ii) Wt. % of these gases.

iii) Average molecular weight.

iv) Wt. of $CO_2$ in kg.

b) In a double effect evaporator plant, the second effect is maintained under vacuum of 512 mm Hg. Find the absolute pressure in kPa, bar and psi. **[6]**

c) What are the applications of process calculations in a process plant? **[2]**

OR

***Q2)*** a) An aqueous solution of oxalic acid of 45% concentration (by mass) has density 1.04 kg/lit at 25°C. Find molarity, normality and molality of the solution. **[6]**

***P.T.O.***

b) Rate of heat loss from a horizontal pipe to the atmosphere by both, convection and conduction is expressed as : $\frac{q}{A}=0.5\frac{\Delta T^{1.25}}{D_0{}^{0.25}}$,

where q : rate of heat loss, Btu/hr, A : Area, $ft^2$, Temperature T in °F, and diameter D in inch. Express this equation in C.G.S. units. **[6]**

c) The available nitrogen in a urea sample is found to be 43.6% (by mass). Find the actual urea content of the sample. **[4]**

***Q3)*** a) Acetylene gas is produced according to following reaction : **[6]**

$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$. Calculate the number of hours of service that can be derived from 1 kg of calcium carbide in an acetylene lamp burning 0.1 $m^3$ of gas per hour at temperature of 298 K and pressure of 99.325 kPa.

b) A gas containing 2% $NH_3$, 25.4% $N_2$ and the rest $H_2$ is flowing in a pipe. To measure the flow rate an ammonia rich gas containing 96% $NH_3$, 3% $H_2$ and 1% $N_2$ is sent at a rate of 100 cc/min. the concentration of $NH_3$ in the down stream is 6%. Find the flow rate of gas inlet. **[4]**

c) Define (any three) : **[6]**

i) Fractional Conversion,

ii) Extent of Reaction,

iii) Selectivity,

iv) Yield.

OR

***Q4)*** a) The feed to a fractionating system is 30,000 kg/hr of 50% benzene, 30% toluene and 20% xylene. The fractionating system consists of two towers No. I and No. II. Feed enters tower I. The overhead product of tower I is a x kg/hr of 95% benzene, 3% toluene and 2% xylene. The bottom of tower I is given as feed to tower II resulting in an overhead product of y kg/hr of 3% benzene, 95% toluene and 2% xylene while the bottom from tower II is z kg/hr of 1% benzene, 4% toluene and 95% xylene. Find x, y and z. **[8]**

b) Centrifuge is fed with a slurry containing 25% solids by weight and wet solids obtained after filteration are analyzed to contain 8% moisture by weight and filterate is found to contain 200 ppm solids. If centrifuge machine produces 100 kg per hour desired wet product and quantity of slurry to be handled is 5000 kg per batch calculate **[8]**

i) the time required for filteration of slurry and

ii) loss of solids in filtrate per batch.

***Q5)*** a) Define : Absolute Humidity, Percentage Humidity and Enthalpy of Humid Air. **[6]**

b) Calculate the total pressure and composition of the vapors in contact with the solution of Benzene (35%), Toluene (40%) and Xylene (25%), by weight at 100°C. Vapor pressure at 100°C are as follows :

Benzene : 1340 mm Hg; Toluene : 560 mm Hg; Xylene : 210 mm Hg. **[6]**

c) An inspector files a report against a factory owner charging him that the $CO_2$ content of the gases leaving the chimney rises above 15% being dangerous to health and against city code. The factory owner burns natural gas containing 100% $CH_4$ and the air supply adjusted to provide 130% excess air. Is the inspectors charge correct? **[6]**

OR

***Q6)*** a) Explain the following : **[8]**

i) Law of corresponding states,

ii) Utility of Equation of states,

iii) Compressibility factor charts,

iv) Flash calculations.

b) A mixed acid is prepared from spent acid using 99% $H_2SO_4$ and 95% $HNO_3$. Determine : **[6]**

i) The mass of sulfuric acid and nitric acid necessary to convert 1000 kg of spent acid containing 40% $H_2SO_4$, 20% $HNO_3$ and 40% $H_2O$ to a mixed acid containing 50% $H_2SO_4$, 40% $HNO_3$ and 10% $H_2O$.

ii) The mass of water that must be evaporated from 1000 kg spent acid given above to produce a mixed acid containing 66% $H_2SO_4$, 33% $HNO_3$ and 1% $H_2O$. All percentages are on weight basis.

c) Explain the stepwise procedure for obtaining Bubble Point for a multi-component mixture – Give expression. **[4]**

## SECTION - II

***Q7)*** a) A sample of fuel oil has C/H ratio 9.5 (by weight) and contains 2% (weight %) sulfur. The Net Calorific value of the fuel oil is 39685 kJ/kg at 298 K. Calculate its gross calorific value using latent heat of water at 298 K. **[6]**

b) Dry Methane is burned with dry air and both are initially at 25°C. The flame temperature is 1297°C. If complete combustion is assumed, how much excess air is to be used?

Data : Heat of reaction = $-0.2*10^6$ cal Cp for components in cal/Mol °C are $CO_2$ = 12.37; $H_2O$ = 9.6; $N_2$ = 7.68 and air = 7.74. **[6]**

c) Explain Proximate and Ultimate analysis of coal. **[4]**

OR

***Q8)*** a) Explain in detail the construction of Psychrometric chart and give its utility with suitable example. **[6]**

b) Dry air is blown through acetone at 300 K and a constant pressure of 101.3 kPa. If it is desired that 5 kg of acetone be evaporated what is the minimum amount of dry air required in kilograms? The vapor pressure of acetone is 16.82 kPa at 300 K. **[6]**

c) A spherical storage tank of 3 m in diameter is half filled with 12500 kg of an organic liquid at 7000 kPa. If the total internal energy in the tank is $5.3 * 10^6$ kJ, what is the specific enthalpy of the fluid in the tank? **[4]**

***Q9)*** a) In a commercial process, chlorine is manufactured by burning hydrogen chloride gas using air. Generally 35% excess air is used. Assume that the oxidation is 80% complete and the dry air and hydrogen chloride gas enter the burner at 298.15. Calculate the composition of dry gases leaving the burner and the adiabatic reaction temperature of the product gas stream. **[6]**

b) Write a short note on enthalpy changes accompanying chemical reactions. **[6]**

c) One kg of water is heated from 250 K to 400 K at one standard atmospheric pressure. The heat requirement is to be calculated. What data you will require to solve this problem and give the steps involved in this solution. **[4]**

OR

***Q10)*** a) A stream flowing at a rate of 15000 mol/hr containing 25 mole % $N_2$ and 75 mole % $H_2$ is to be heated from 25°C to 200°C. Calculate the heat to be transferred. Cp data is as follows : **[6]**

| Gas | a | ,b * $10^3$ | ,c * $10^6$ | ,d * $10^9$ |
|---|---|---|---|---|
| $N_2$ | 25.5909 | -5.41 | 13.1829 | -4.968 |
| $H_2$ | 28.6105 | 1.0194 | -0.1476 | 0.769 |

b) The molar heat capacity of CO is given by

$C_p = 26.586 + 7.582 * 10^{-3} T - 1.12 * 10^{-6} T^2$ where $C_p$ is in kJ/kmol K and T is in K. **[6]**

i) Calculate the mean molar heat capacity in the temperature range of 500 - 1000 K.

ii) CO enters a heat exchanger at a rate of 500 cubic meters per hour at STP. Calculate the heat to be supplied to the gas to raise its temperature from 500 to 1000 K.

c) What is Adiabatic flame temperature? Discuss the procedure to find Adiabatic flame temperature. **[4]**

***Q11)*** a) A theoretical producer gas (34.7% CO, 65.3% $N_2$) at 25°C is burnt with 100% excess air (preheated to 250°C). Conversion of CO to $CO_2$ is 90%.

Calculate the theoretical flame temperature.

Data : heat of formation, kcal/gm mole at 25°C of $CO_2$ = -94.052; CO = -26.412. Specific heat, Cal/gm mole °K of $O_2$ = 6.935 + 0.000677 T; $CO_2$ = 9.085 + 0.0048 T; $N_2$ = 6.499 + 0.001413 T and CO = 6.350 + 0.00018 T. **[12]**

b) A tank contains 10 $m^3$ of fresh water. Brine having a concentration of 10 kg salt per $m^3$ is sent into the tank at the rate of 250 lit/min. the mixture is kept uniform by mixing and runs out at the rate of 125 lit/min. what will be the exit brine concentration when the tank contains 20 $m^3$ of brine. **[6]**

OR

***Q12)*** a) An inventor thinks he has developed a new catalyst which can make the gas phase reaction $CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$ proceeds to 100% conversion. The reactants enters and products leave at 500°C. The inventor makes an arrangement to remove 35,000 kcal/kmole $CO_2$, of heat. Justify the inventors arrangement and suggest rectification if necessary. **[12]**

Data : heat of formation, kcal/k mole at 25°C of $CO_2$ = -94052; $CH_4$ = -17889 and $H_2O$ = -57798

| Component | a | ,b * $10^3$ | ,c * $10^6$ |
|---|---|---|---|
| $CO_2$ | 6.339 | 10.14 | -3.415 |
| $H_2$ | 6.424 | 1.039 | -0.078 |
| $H_2O$ | 6.97 | 3.464 | -0.483 |
| $CH_4$ | 3.204 | 18.41 | -4.48 |

b) How Heat of Solution and Heat of Mixing are determined - Explain with help of suitable example. **[6]**

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**Total No. of Questions : 12]** **[Total No. of Pages : 4**

**P1200**

# [3662]-289
## S.E. (Biotechnology)
## THERMODYNAMICS
## (215468) (2003 Course) (Sem. - II)

***Time : 3 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates :***

1) ***Figures to the right indicate full marks.***
2) ***Use of programmable calculator is not allowed.***
3) ***Draw a neat sketch wherever necessary.***
4) ***Make necessary assumptions wherever required.***
5) ***Answer any three questions from Section-I and any three questions from Section-II.***

## SECTION - I

***Q1)*** a) What do you mean by the number of degrees of freedom? What is the number of degrees of freedom when a binary liquid mixture is in equilibrium with its vapor? **[4]**

b) A cylinder is filled with nitrogen gas to a pressure of 13.7 MPa at 25°C. Suppose the cylinder is insulated and the gas is allowed to impinge on impeller blades, by opening the cylinder valve the impeller rotates and does work. Is the cylinder a perpetual motion machine of the first kind? Explain. **[4]**

c) Distinguish between the extensive and intensive properties. State whether the following properties are intensive or extensive. **[8]**

i) Specific Volume.

ii) Density.

iii) Heat capacity.

iv) Specific Heat.

OR

***Q2)*** a) Explain Carnot cycle and prove Carnot theorem. **[8]**

b) It is planned to maintain a large lecture hall at 25°C in summer as well as in winter. The minimum temperature in winter is 3°C while the maximum temperature in summer is 40°C. The rate of energy loss through the walls and roofing is estimated at 20kJ/s. Determine the minimum power required to maintain the hall in summer and in winter if the same device is used as a refrigerator in summer and as a heat pump in winter. **[8]**

***P.T.O.***

***Q3)*** a) Using Hess's law, calculate the heat of formation of chloroform ($CHCl_3$) with the following given data :- **[8]**

i) $CHCl_{3(g)} + ½O_{2(g)} + H_2O_{(1)} \rightarrow CO_{2(g)} + 3HCl_{(g)}$ $\Delta H°_{298} = -509.93kJ$

ii) $H_{2(g)} + ½O_{2(g)} \rightarrow H_2O_{(1)}$ $\Delta H°_{298} = -296.03kJ$

iii) $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H°_{298} = -393.78kJ$

iv) $½H_{2(g)} + ½Cl_{2(g)} \rightarrow HCl_{(g)}$ $\Delta H°_{298} = -167.57kJ$

b) Write short note on latent heat of pure substances. **[4]**

c) Suppose a piston-cylinder assembly contains one mole of $CO_2$ at 0.101325 MPa and 300 K. The cylinder is placed on a hot plate allowing the gas to expand at constant pressure till the temperature rises at 400 K. Calculate the change in entropy of $CO_2$. **[4]**

For $CO_2$ $C_P^\circ = 45.369 + 8.688* 10^{-3}T - 9.619* 10^5T^{-2}$.

OR

***Q4)*** a) Derive expression of temperature dependence of standard heat of reaction ($\Delta H°$). **[8]**

b) What are sensible heat effects? Find relation between heat capacity and temperature. **[8]**

***Q5)*** a) What are partial properties? What is its physical significance? Derive expression for partial volumes of binary solution. **[10]**

b) What is chemical potential? Express the definition with mathematical statement. **[8]**

OR

***Q6)*** a) Find and express; relation between excess properties and residual properties. **[6]**

b) Prove the following : **[12]**

i) $(\partial T / \partial V)s = -(\partial P / \partial S)v$

ii) $(\partial T / \partial P)s = (\partial V / \partial S)p$

iii) $(\partial P / \partial T)v = (\partial S / \partial V)T$

iv) $(\partial V / \partial T)p = -(\partial S / \partial P)T$

## SECTION - II

***Q7)*** a) Explain the Duhem's theorem. What is its significance in establishing the state of the system? **[4]**

b) Derive the expression of phase rule for non reacting systems. **[4]**

c) 100 g each of ethanol and methanol are mixed at 20°C to prepare an ideal mixture. The vapor pressure of the pure methanol is 88.7 mm and that of ethanol is 44.5 mm at 20°C. Calculate **[8]**

i) The vapor pressure of solution.

ii) Partial vapor pressures of ethanol and methanol in solution.

iii) The vapor phase composition.

OR

***Q8)*** a) Explain in a detail Roult's law and its application to thermodynamic systems. Why modified Roult's law is required explain in detail. **[8]**

b) An equimolar solution of benzene and toluene is totally evaporated at a constant temperature of 363 K. At this temperature the vapor pressures of benzene and toluene are 135.4 and 54 KPa respectively. What are the pressures at the beginning and at the end of the vaporization process? **[8]**

***Q9)*** a) Explain the criteria for chemical reaction equilibrium. **[4]**

b) Calculate the equilibrium constant at 298 K of the reaction.

$N_2O_{4(g)} \rightarrow 2NO_{2(g)}$

Given that the standard free energies of formation at 298K are 97,540 J/mol for $N_2O_4$ and 51,310 J/mol for $NO_2$. **[4]**

c) A gas mixture containing 3 mol $CO_2$, 5 mol $H_2$ and 1 mol water is undergoing the following reactions:

$CO_2 + 3H_2 \rightarrow CH_3OH + H_2O$

$CO_2 + H_2 \rightarrow CO + H_2O$

Develop expressions for the mole fraction of the species in terms of the extent of the reaction. **[8]**

OR

***Q10)*** a) Explain the effect of temperature on Equilibrium Constant. **[8]**

b) Explain in detail Phase rule and Duhem's theorem for reacting system. **[8]**

***Q11)*** Define first and second law of thermodynamics. Explain its application to Biological systems in detail. **[18]**

OR

***Q12)*** What is Gibb's free energy? Explain in detail applications of Gibb's free energy to biological systems. **[18]**

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**Total No. of Questions : 12]** **[Total No. of Pages : 4**

**P1223**

# [3662]-37

## S.E. (Mech. S/W)

## PRODUCTION ENGINEERING - II

## (2003 Course)

***Time : 3 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates :***

1) ***Answer three questions from Section-I and three questions from Section-II.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
5) ***Assume suitable data, if necessary.***

## SECTION - I

***Q1)*** a) In an orthogonal cutting operation following data have been observed: **[10]**

| | | |
|---|---|---|
| Cutting speed | = | 2 m/s |
| Width of chip | = | 5 mm |
| Rake angle | = | 15 |
| Cutting force | = | 500 N |
| Thrust force | = | 225 N |
| Chip thickness | = | 0.228 mm |
| Uncut chip thickness | = | 0.129 mm |

Determine shear stress along the shear plane and power for the cutting operation and also find chip velocity, shear strain in chip and shear strain rate. Take shear zone thickness equal to one tenth of shear plane length.

b) Show that $\tan \Phi = \dfrac{r Cos\alpha}{1 - r Sin\alpha}$ **[6]**

where $\Phi$ = shear plane angle

r = chip thickness or cutting ratio

$\alpha$ = rake angle.

OR

***P.T.O.***

***Q2)*** a) The following equation for tool life is given for a turning operation $VT^{0.15}\ f^{0.8}\ d^{0.4} = C$. A 40 min. tool life was obtained while cutting at V = 35 m/min, f = 0.4 mm/rev, d = 3 mm. Calculate the change in tool life if the cutting speed, feed and depth of cut are increased by 15% individually and taken together. Also comment on tool life. **[6]**

b) What is machinability? And list the factors affecting it. **[5]**

c) Sketch and label the terminology of single point cutting tool. **[5]**

***Q3)*** a) Explain types of broaching machine. **[6]**

b) Write advantages and limitations of broaching. **[5]**

c) Explain the working principle of gear cutting using a rack type shaper cutter. **[5]**

OR

***Q4)*** a) Explain the types of gear hobbing. **[6]**

b) Explain the types of thread rolling machines. **[6]**

c) Explain the thread milling process. **[4]**

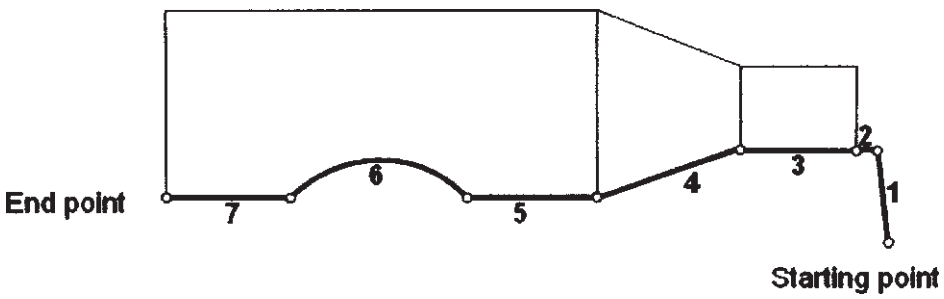
***Q5)*** a) What do you mean by the term : **[6]**

i) Hard wired and soft wired program.

ii) Open loop and closed loop system.

b) Distinguish between NC and CNC. **[6]**

c) Movement of the tool is shown in fig. what codes will you select from starting the machine and coolant to stopping the machine and coolant in sequence shown mentioning the absolute coordinate system. **[6]**



OR

***Q6)*** Write a short note on : **[18]**

a) Automatic tool changer.

b) DNC.

c) NC words

## SECTION - II

***Q7)*** a) Explain with neat sketch 'EDM' machining process stating its advantages, limitations and applications. **[8]**

b) Explain the process of 'LBM' machining and parameters that controls the process. **[8]**

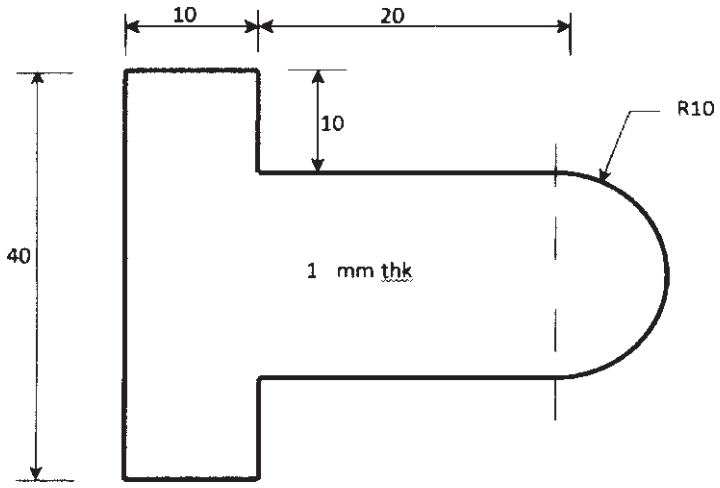
OR

***Q8)*** Write a short note on : **[16]**

a) EBM.

b) ECM.

***Q9)*** a) Find out the cutting force and center of pressure for the given component. Also find the punch size and die size if the shown profile is to be blanked and pierced. Given $\tau_s$ = 200 N/mm$^2$. Clearance = 5% of thickness. **[8]**




b) Distinguish between compound and combination die. **[4]**

c) What is the function of stripper? List types of stripper and explain any one with neat sketch. **[4]**

OR

***Q10)*** a) Draw the strip layout showing scrap bridge, front scrap, back scrap, feed for each piece, scrap. Also write the relations to find feed, no. of pieces and percentage utilization. **[6]**

b) A cup 75 mm in diameter and 50 mm deep is to be drawn from 1.6 mm thick drawing sheet with yield strength of 410 N/mm$^2$. The corner radius is 1.5 mm. Determine : **[10]**

i) Blank diameter.

ii) No. of draws required.

iii) Force required for each draw considering 50%. 32% reduction for the successive draw.

iv) Considering area based method height of the cup after each draw (c = 0.6)

***Q11)*** Write a short note on (any 3) : **[18]**

a) Indexing methods in Jigs and Fixture.

b) Angle type of jig.

c) Box type of jig.

d) Modular fixture.

OR

***Q12)*** a) Points to be considered while designing jig and fixture and list advantages of jigs and fixtures. **[8]**

b) Explain the function of elements used in fixture : Set block, Tenon/key, Locators and clamps. **[5]**

c) List types of bush and explain with neat sketch slip and fix type of renewable bush. **[5]**

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**Total No. of Questions : 12]** **[Total No. of Pages : 4**

**P 1284** **[3662] - 36**

# S.E. (Mechanical Sandwich)

## THEORY OF MACHINE AND MACHINE DESIGN - I

## (2003 Course)

***Time : 4 Hours]*** ***[Max. Marks : 100***

***Instructions to the candidates:***

1) ***Answer three questions from Section I and three questions from Section II.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of electronic pocket calculator is allowed.***
6) ***Assume suitable data, if necessary.***

## SECTION - I

***Q1)*** a) Explain with neat sketches inversions of single slider crank chain giving their practical applications. **[8]**

b) Explain with neat sketches Davis Steering Gear and Ackerman Steering Gear mechanism. **[8]**

OR

***Q2)*** a) Establish the relation between input and output speed of 'Single Hookes Joint' in which the angle between the shaft is $\alpha^{o}$. Give any one specific application of Hooke's joint. **[8]**

b) Write short notes on **[8]**

i) Degrees of freedom in mechanisms.

ii) Geneva mechanism.

***Q3)*** a) In a slider crank mechanism, the length of the crank and connecting rod are 150 mm and 600 mm respectively. The crank position is $60^{o}$ from inner dead centre. The crank shaft speed is 450 r.p.m. (clockwise). Using analytical method, determine **[6]**

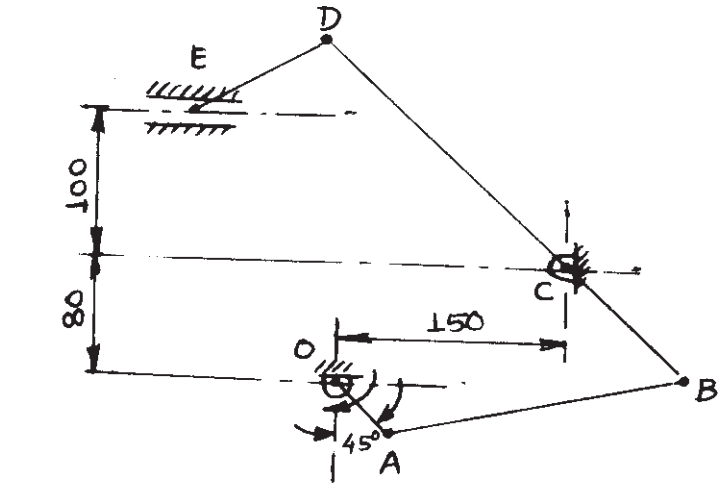
i) Velocity and acceleration of slider.

ii) Angular acceleration of the connecting rod.

b) Fig. 1 shows part of an opposed piston engine mechanism. The velocity of the piston E for the given instant is 780 mm/s. The crank 'OA' rotates at uniform speed in clockwise direction and makes an angle of $45^{o}$ to

***P.T.O.***

vertical as shown in the figure. Draw velocity and acceleration diagram and determine




OA = 50 mm
BC = 110 mm
DE = 100 mm
AB = 200 mm
CD = 220 mm

Fig. 1

i) The speed of crank in r.p.m.

ii) Angular velocity of link BCD.

iii) Acceleration of piston E. **[10]**

OR

***Q4)*** a) State and prove Kennedys theorem of three centres in line. Also explain the application of Kennedys theorem. **[8]**

b) Write a short notes on : **[8]**

i) Velocity and acceleration analysis by loop closure equation.

ii) Kleins construction.

***Q5)*** a) The following data refer to a steam engine **[10]**

Stroke = 600 mm

Diameter of piston = 240 mm

Length of connecting rod = 1.5 m

Mass of reciprocating parts = 300 kg

Mass of connecting rod = 250 kg

Speed = 125 r.p.m.

Centre of gravity of connecting rod from crank pin = 500 mm

Radius of gyration of connecting rod about an axis through the centre of gravity = 650 mm.

Determine the magnitude and direction of the torque exerted on the crank shaft when the crank has turned through $30^{o}$ from inner dead centre. Use Graphical method.

b) Write a short notes on **[8]**

i) Dynamically equivalent system.

ii) Trifilar suspension.

OR

***Q6)*** a) Solve Q.No.5(a) using analytical method. **[10]**

b) Write a short notes on **[8]**

i) Compound pendulum.

ii) Inertia of geared system.

## SECTION - II

***Q7)*** a) What is torsional and lateral rigidity of shaft? **[4]**

b) Explain different types of keys with neat sketches. **[6]**

c) A 16 x 10 $mm^2$ cross section parallel key is to be used to transmit 60 kW power at 1440 r.p.m. from a shaft of 45 mm diameter. The key is made of plain carbon steel with yield strength of 300 $N/mm^2$. If the required safety margin is 3, determine the key length. **[6]**

OR

***Q8)*** a) Determine the deflection of a cantilever beam of length 'L' under the force 'F' acting at the free end, by using Castigliano's theorem. Assume uniform flexural rigidity. **[6]**

b) With the help of neat sketches, explain the design procedure of rigid flange coupling. **[10]**

***Q9)*** a) Compare various thread forms used in power screw applications. **[6]**

b) What do you understand by bolts of uniform strength? Where are they used? **[6]**

c) Write a note on 'Recirculating Ball Screw'. **[4]**

OR

***Q10)***a) Write a note on 'Differential and Compound screws'. **[6]**

b) A bracket plate carrying a load of 120 kN is to be welded to a column as shown in Fig.2. Find the size of the weld, if the allowable shear stress in the weld is 110 MPa. **[10]**

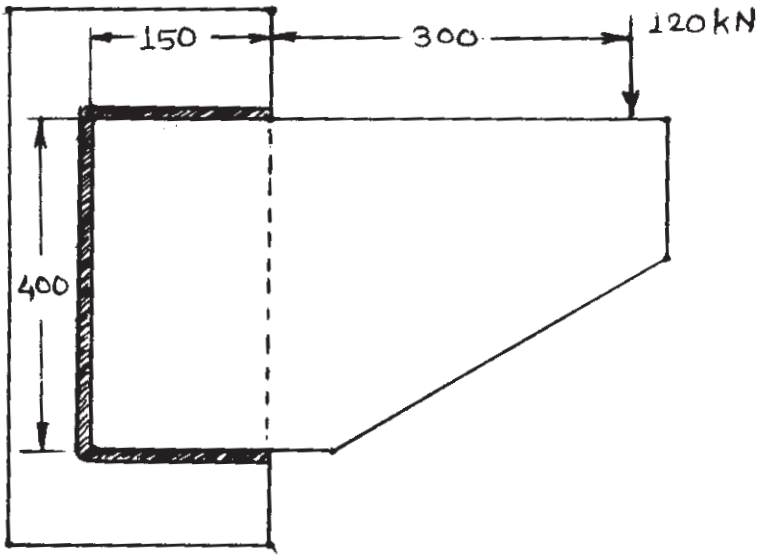



Fig. 2

***Q11)***a) Explain the phenomena of 'slip' and 'creep' in a belt drive. **[4]**

b) Derive an expression for the ratio of the driving tensions in flat belt drive. **[6]**

c) A pulley used to transmit power by means of ropes has a diameter of 3.6 metres and has 15 grooves of $45^{o}$ angle. The angle of contact is $170^{o}$ and the coefficient of friction between the ropes and groove sides is 0.28. The maximum possible tension in the ropes is 960N and the mass of the rope is 1.5 kg per metre length. What is the speed of pulley in r.p.m. and the power transmitted if the condition of maximum power prevail. **[8]**

OR

***Q12)***a) Explain with neat sketches the power transmission chains. **[5]**

b) Explain procedure for selection of flat belts from manufacturer's catalogue. **[5]**

c) A chain drive is used for reduction of speed from 240 r.p.m. to 120 r.p.m. The number of teeth on the driving sprocket is 20. Find the number of teeth on the driven sprocket. If the pitch circle diameter of the driven sprocket is 600 mm and centre to centre distance between the two sprockets is 800 mm, determine the pitch and length of the chain. **[8]**