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10EE61

Sixth Semester B.E. Degree Examination, June/July 2013
Power System Analysis and Stability

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Draw the per phase basis, representation of synchronous machine, transmission line and transformer. **(04 Marks)**

b. Derive an equation for per unit impedance if a change of base occurs. **(03 Marks)**

c. Draw the pu impedance diagram of power system shown in Fig.Q.1(c).

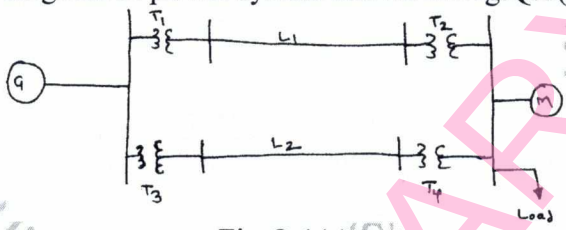


Fig.Q.1(c)

Ratings:

Generator G	: 22kV, 90 MVA, $x_d'' = 18\%$
Transformer T_1	: 22/220 kV, 50MVA, x = 10%
Line L_1	: j 48.4Ω
Transformer T_2	: 11/220 kV, 40 MVA, x = 6%
Transformer T_3	: 22/110 kV, 40 MVA, x = 6.4%
Line – 2	: j65.43 Ω
Transformer, T_4	: 11/110kV, 40 MVA, x = 8%
Motor m	: 10.45 kV, 66.5 MVA, $x_d'' = 18.5\%$
Load	: 57 MVA, 0.6pf lag, 10.45 kV

Take base kV = 22 and base MVA = 100 in the generator circuit. **(13 Marks)**

2 a. With the help of waveform at the time of three phase symmetrical fault, on synchronous generator define steady state, transient and subtransient reactances. **(07 Marks)**

b. A synchronous generator and synchronous motor each rated 25MVA, 11kV having 15% subtransient reactance are connected through transformers and a line as shown in Fig.Q.2(b). The transformers are rated 25 MVA, 11/66 kV and 66/11kV with leakage reactance of 10% each. The line has a reactance of 10% on a base of 25MVA, 66kV. The motor is drawing 15MW at 0.8 pf leading and a terminal voltage of 10.6 kV when a symmetrical three phase fault occurs at the motor terminals. Find the subtransient current in the generator, motor and fault. Take 25MVA and 11kV base values in generator circuit. **(13 Marks)**

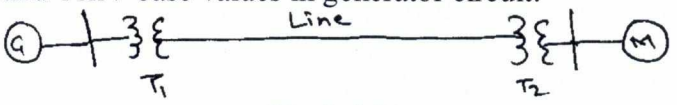


Fig.Q.2(b)

3 a. Derive phase currents of unbalanced system in terms of sequence currents. **(07 Marks)**

b. Develop an expression for three phase power in terms of symmetrical components. **(07 Marks)**

c. Find the symmetrical components for the given three phase currents.

$I_a = 10\angle 0^\circ$ A $I_b = 10\angle -90^\circ$ A $I_c = 15\angle 135^\circ$ A. **(06 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

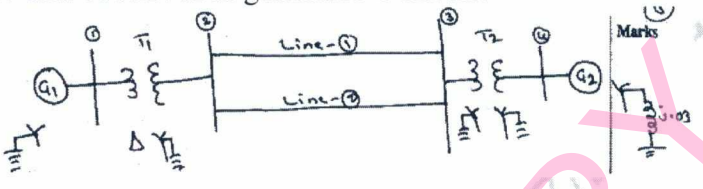
4 a. Draw zero sequence equivalent circuit at three phase transformer banks, together with diagram of connections and the symbols for one line diagram. **(05 Marks)**

b. Fig.Q.4(b) shows a power system network. Draw positive, negative and zero sequence network. The system data is as under:

Equipment	MVA rating	Voltage rating	X_1 (pu)	X_2 (ou)	X_0(pu)
Generator – 1	100	11 kV	0.25	0.25	0.05
Generator – 2	100	11 kV	0.2	0.2	0.05
Transformer – T_1	100	11/220 kV	0.06	0.06	0.06
Transformer – T_1	100	11/220 kV	0.07	0.07	0.07
Line – 1	100	220 kV	0.1	0.1	0.3
Line – 2	100	220 kV	0.1	0.1	0.3

Take a base of 11kV and 100MVA in generator-1 circuit. **(15 Marks)**

Fig.Q.4(b)



PART – B

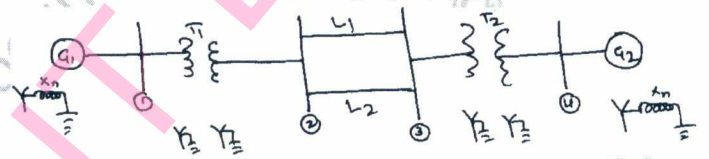
5 a. Derive an expression for fault current for line-to-line fault on an unloaded generator. **(08 Marks)**

b. A salient-pole generator without dampers is rated 20MVA, 13.8 kV and has a direct axis subtransient reactance of 0.25pu. The negative and zero sequence reactances are, respectively 0.35 and 0.10 pu. The neutral of the generator is solidly grounded. Determine the subtransient current in the generator and the line-to-line voltages for subtransient conditions when a single line-to-ground fault occurs at the generator terminals with the generator operating unloaded at rated voltage. Neglect resistance. Take base of 20MVA, 13.8kV. **(12 Marks)**

6 a. Write a note on open conductor fault in power system. **(06 Marks)**

b. Determine the fault current at the faulted bus for a line to line fault, which occurs between phases 'b' and 'c' at bus ④ as shown in the Fig.Q.6(b).

Fig.Q.6(b)



G_1 and G_2 : 100 MVA, 20kV, $x_1 = x_2 = 15\%$, $x_0 = 4\%$, $x_n = 6\%$
T_1 and T_2 : 100 MVA, 20/345 kV, $X_{lekage} = 9\%$
L_1 and L_2 : $x_1 = x_2 = 10\%$, $x_0 = 40\%$ on the base of 100MVA, 345 kV
Choose a base of 100MVA and 345kV in transmission line. **(14 Marks)**

7 a. What is swing equation? And hence derive swing equation for a single machine connected to an I.B. **(08 Marks)**

b. A 50Hz generator is delivering 50% of the power that it is capable of delivering through a transmission line to an infinite bus. A fault occurs that increases the reactance between the generator and the infinite bus to 500% of the value before three faults when the fault is isolated, the maximum power that can be delivered is 75% of the original maximum value. Determine the critical clearing angle for the condition described. **(12 Marks)**

8 Write short notes on the following:

a. Line-line-ground fault on unloaded generator.
b. Stead state and transient stability.
c. Analysis of three phase induction motor with one line open.
d. Equal area criterion. **(20 Marks)**

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10EE62

Sixth Semester B.E. Degree Examination, June/July 2013

Switch Gear and Protection

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Write a short note on energy management of power system. **(05 Marks)**

b. What is the function of an isolating switch in power system? Draw and explain the operation of vertical break isolator. **(07 Marks)**

c. Define: i) Fuse, ii) Rated current of fuse, iii) Fusing current, iv) Fusing factor. **(08 Marks)**

2 a. Explain the phenomenon of arc and how it is maintained in the circuit breaker. **(08 Marks)**

b. Explain the arc interruption theories of ac circuit breaker. **(06 Marks)**

c. For a 132 KV system the reactance and capacitance upto the location of circuit breaker is 3Ω and 0.015 μF respectively. Calculate:
i) Frequency of transient oscillations
ii) Maximum value of restriking voltage and
iii) Maximum value of RRRV. **(06 Marks)**

3 a. With a neat diagram, explain cross blast circuit breaker. **(06 Marks)**

b. Explain with a neat diagram, the construction and working of minimum oil circuit breaker. **(08 Marks)**

c. Explain the following with reference to circuit breaker:
i) Breaking capacity ii) Making capacity and iii) Short time current rating **(06 Marks)**

4 a. What is synthetic testing of circuit breaker? With a neat circuit, explain the two types of synthetic testing. **(10 Marks)**

b. List the various causes of over voltage in power system. **(04 Marks)**

c. Explain the basic principle of operation of lightning arrestor. **(06 Marks)**

PART – B

5 a. With a diagram, explain zones of protection in a power system. **(06 Marks)**

b. What are the essential qualities of a protective relay? Explain them briefly. **(10 Marks)**

c. How protective relays are classified? List them. **(04 Marks)**

6 a. Differentiate between IDMT over current relay and extremely inverse time over current relay characteristics. **(05 Marks)**

b. Explain with a neat circuit, the working of voltage balance differential relay. **(05 Marks)**

c. Explain the principle of three stepped distance protection of transmission line. **(10 Marks)**

7 a. Which are the various abnormal running conditions that may occur in a generator? Explain them briefly. **(10 Marks)**

b. The neutral point of a 10 KV alternator is earthed through a resistance of 10Ω, the relay is set to operate when there is an out of balance current of 1A. The CTs have a ratio of 1000/5. What percentage of winding is protected against fault to earth and what must be the minimum value of earthing resistance to give 90% protection to each phase winding? **(10 Marks)**

8 a. What are the different types of faults that may occur in transformers in service? Explain them briefly. **(06 Marks)**

b. Write a note on differential protection of transformers. **(04 Marks)**

c. Draw and explain the ground fault protection of induction motor. **(10 Marks)**

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10EE63

Sixth Semester B.E. Degree Examination, June/July 2013

Electrical Machine Design

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What are the electrical properties of insulating materials? Classify the insulating materials used in electrical machines according to their thermal stability in service. **(06 Marks)**

b. What are the advantages and disadvantages of large number of poles in D.C. machines? **(04 Marks)**

c. A 5kW, 250V, 4 pole, 1500 rpm shunt generator is designed to have a square pole face. The loadings are:
Average flux density in the gap = 0.42 Wb/m^2
Ampere conductors per metre = 15000
Find the main dimensions of the machine.
Assume full load efficiency = 87% and ratio of pole arc to pole pitch = 0.66. **(10 Marks)**

2 a. An electromagnetic coil has an internal diameter of 0.8 m and external diameter of 0.4 m. Its height is 0.2 m. The outside cylindrical surface of the coil can dissipate 1000 W/m^2. Calculate the total mmf per coil if the voltage applied across the coil is 50 volts. Assume the space factor to be 0.6 and the resistivity of the wire to be 0.02 Ω/m/mm? **(10 Marks)**

b. Determine the total commutator losses for a 1000 KW, 500 V, 300 rpm, 10 pole, d.c. generator. Diameter of commutator = 100 cm, current density for the brush = 7.5 A/cm^2, brush pressure = 1500 kgf/m^2. Assume lap winding, brush contact drop = 2V. Coefficient of friction = 0.2, armature current = F.L. current. **(10 Marks)**

3 a. Why the core of the transformer is stepped? Why the width of the central limb of shell type transformer is taken double? **(06 Marks)**

b. Define iron space factor. **(02 Marks)**

c. Determine the dimensions of core and yoke for a 200 kVA, 50 Hz, 1 phase core type transformer. A cruciform core is used with distance between adjacent limbs equal to 1.6 times the width of core laminations. Assume voltage per turn = 14 V, maximum flux density = 1.1 Wb/m^2, window space factor = 0.32, current density = 3 A/mm^2 and stacking factor = 0.9.

The net iron area is 0.56 d^2, where d is the diameter of circumscribing circle. Also the width of the largest stamping is 0.85 d. Assume CRGO steel. **(12 Marks)**

4 a. Compute the active and reactive components of no load current of 6600/440 volts, 50 Hz, 1ϕ core type transformer with the following particulars:
Mean length of magnetic path = 300 cm
Gross cross sectional area = 150 cm^2
Maximum fluxdensity = 1.5 Tesla
Specific core loss = 2.5 watts/kg
Ampere turns/cm at 1.15 Tesla = 7.0
Specific gravity of core material = 7.5 gm/cm^3
The effect of joints is equivalent to an air gap of 1 mm in the magnetic circuit. **(10 Marks)**

4 b. The tank of a 300 kVA, 3ϕ oil immersed self cooled transformer is 145 cm in height and 55 cm × 115 cm in plan. The full load to be dissipated is 5.5 kW. Find the number of cooling tubes necessary to limit the temperature raise of the tank walls to 35°C. The tubes are 5 cm in diameter and have an average length of 100 cm. Neglect heat dissipation from top and bottom surfaces. Tank surface dissipates heat due to convection at the rate of 6.5 $W/m^2/^oC$ and due to radiation at the rate of $6W/m^2/^oC$. Heat dissipated from the tube surface by convection is improves by 35%. **(10 Marks)**

PART – B

5 a. Derive the output equation of an induction motor. **(10 Marks)**

b. Find the main dimension, number of stator turns, size of conductors and number of slots of a 5 HP, 400 V, 3ϕ, 50 Hz, 4 pole, squirrel cage induction motor using delta starter. Assume the following data:
Average flux density in air gap = 0.46 T
Amp. Conductor/m at armature periphery = 22×10^3
Full load efficiency = 83%
Full load p.f. = 0.84 (lag)
Winding factor = 0.955, current density = 4 A/mm^2
Number of slots/pole/phase = 3
Take L/T = 1.5 **(10 Marks)**

6 a. A 3ϕ, 11 kW, 440 V, 50 Hz, 6 pole delta connected squirrel cage induction motor has 54 stator slots each containing 28 conductors. Calculate the value of bar and end ring currents. The number of rotor slots is 57. The machine has an efficient of 86% and a power factor of 0.85. The rotor mmf is 80% of stator mmf. **(10 Marks)**

b. Mention the types of leakage reactances and draw the phasor diagram of an induction motor neglecting the loss component of no load current and the leakage reactance of rotor winding. **(05 Marks)**

c. Determine the leakage permeance per metre length of rectangular semienclosed slot having the following dimension in mm.
Slot width = 10
Slot opening = 4
Height of conductor portion = 25
Height above conductor but below wedge = 1
Wedge height = 3
Lip height = 1.5 **(05 Marks)**

7 a. Derive the output equation of a synchronous machine and show that $HP = \frac{\text{Input kVA} \times n \times \cos\theta}{0.746}$. **(10 Marks)**

b. Explain the choice of B_{av} and ac in synchronous machine. **(10 Marks)**

8 a. Obtain the suitable values of diameter and core length for a 1500 kVA, 3300 V, 3ϕ, delta connected, 10 pole alternator which has specific magnetic loading 0.51 T and specific electric loading 34,000 A/m. The ratio of pole pitch to core length is 0.8. Assume winding factor as 0.955, frequency = 50 Hz. **(10 Marks)**

b. Define SCR and explain in detail the effect of SCR on machine performance. **(10 Marks)**

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10EE64

Sixth Semester B.E. Degree Examination, June/July 2013
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. For an N-valued real sequence x(n), prove the following relationships:

i) $DFT[x(n-m)_N] = W_N^{mK} X(K)$

ii) $DFT\, X(K) = Nx(-l)$

iii) $\sum_{K=0}^{N-1} |X(K)|^2 = N \sum_{n=0}^{N-1} |x(n)|^2$ **(08 Marks)**

b. Consider a sequence x(n) = (8, 3, 4, 1, -5, -4, -20, 2, -1, 7, 4). Evaluate the following without explicitly computing X(K).

i) $DFT\, X(K)$

ii) $\sum_{K=0}^{11} |X(K)|^2$

iii) $\sum_{K=0}^{11} e^{\frac{-j\pi K}{6}} X(K)$ **(08 Marks)**

c. Compute the N-point DFT of the sequence $x(n) = \cos\frac{2\pi n}{N}$. Hence find x(n) Ⓝ x(n). x(n) is defined in the range $0 \le n \le N-1$. **(04 Marks)**

2 a. Using overlap and save method, determine the output y(n) of a filter whose impulse response h(n) = (1, 1, 1) to an input x(n) = (3, -1, 0, 1, 3, 2, 0, 1). Use 6-point circular convolution. **(08 Marks)**

b. Determine the output y(n) for a system with h(n) = (1, 2) to an input x(n) = (1, 2, 0, 4) using circular convolution. **(08 Marks)**

c. Bring out a comparison between linear convolution and circular convolution. **(04 Marks)**

3 a. Show that the DFT coefficient X(N+K) and X(N–K) of a 2N valued real sequence x(n) are complex conjugates. **(08 Marks)**

b. Tabulate the comparison of complex multiplications and additions for direct computation of DFT versus the FFT algorithm for N = 32, 128 and 512. **(08 Marks)**

c. The first five points of the 8-point DFT X(K) of a real valued sequence are, (0.25, 0.125–j0.3018, 0, 0.125–j0.518, 0)
Determine the remaining three points. Estimate the value of x(0) **(04 Marks)**

4 a. Develop an 8-point decimation in time FFT algorithm. Draw the complete Signal Flow Graph (SFG). **(08 Marks)**

b. Compute the 4-point DFT of the sequence x(n) = (4, 3, 2, 1), by invoking decimation in frequency FFT algorithm. **(08 Marks)**

c. Develop the DITFFT algorithm for decomposing the DFT of a 6 valued sequence. Draw the signal flow graph (SFG). **(04 Marks)**

PART – B

5 a. Design an analog Butterworth that has a –2 dB or better cut off frequency of 20 rad/sec and at least 10 dB of attenuation at 30 rad/sec. **(08 Marks)**

b. Design a unit bandwidth 3 – dB digital Butterworth filter of order one (ONE) by using bilinear transformation. **(08 Marks)**

c. Bring out a comparison between Butterworth filter and Chebyshev filter. **(04 Marks)**

6 a. Transform $H(s) = \frac{s+a}{(s+a)^2 + b^2}$ into a digital filter using impulse invariance technique. **(08 Marks)**

b. Using the bilinear transformation, $S = \frac{1-z^{-1}}{1+z^{-1}}$, what is the image of $S = e^{\frac{j\pi}{2}}$ in the z plane? **(08 Marks)**

c. A filter is specified by h(n) given by, $h(n) = -\frac{1}{3}\delta(n+1) + \frac{1}{2}\delta(n) - \frac{1}{3}\delta(n-1)$

i) Is it a linear phase filter?
ii) Is it a low-pass or high-pass filter?
iii) Is it a causal filter?
Justify your result. **(04 Marks)**

7 a. Determine the unit sample response of the ideal low pass filter. Can it be physically implemented? Can it exhibit linear phase? Can it be stable? **(08 Marks)**

b. The desired response of a low pass filter is,

$$H_d(e^{j\omega}) = e^{-j2\omega} \qquad -\frac{\pi}{4} \le \omega \le \frac{\pi}{4}$$

$$= 0 \qquad \frac{\pi}{4} < |\omega| \le \pi$$

Determine $H(e^{j\omega})\big|_{FIR}$ using the Hamming window. **(08 Marks)**

c. An FIR filter has the impulse response $h(n) = \underset{\uparrow}{\{1, 2, 1\}}$. Design the corresponding digital filter by the frequency sampling technique. **(04 Marks)**

8 a. Obtain a cascade/series realization for the following H(z):

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{(z-0.25)(z^2 - z + 0.5)}$$ **(08 Marks)**

b. Obtain a parallel realization for the following H(z):

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{(z-0.25)(z^2 - z + 0.5)}.$$ **(08 Marks)**

c. Realize the FIR linear phase filter, with the impulse response,

$$h(n) = \delta(n) - \frac{1}{2}\delta(n-1) + \frac{1}{4}\delta(n-2) + \frac{1}{4}\delta(n-3) - \frac{1}{2}\delta(n-4) + \delta(n-5)$$ **(04 Marks)**

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10EE65

Sixth Semester B.E. Degree Examination, June 2013

(ELECTRICAL & ELECTONICS ENGINEERING)

COMPUTER AIDED ELECTRICAL DRAWING

Time: 3hrs **Max. Marks: 100**

Instruction:

1. **Answer Question 1 and Question 2 from Part A**
2. **Answer Question 3 or Question 4 from Part B**

Use of CAD tool that satisfies the requirements of the syllabus is permitted

Suitable data may be assumed if not given.

Part A

1. Design and draw Developed duplex Winding Diagram for a 18 slots, double layer, 4-pole, Progressive lap winding. Draw the sequence diagram,show position of brush, direction of current etc.

(30 marks)

OR

Draw the developed winding diagram of an AC machine having the following details.

No. of phase = 3

No. of poles = 4

No. of slots = 36 mush winding (30 marks)

2. Draw the Single line Diagram of a generating station having the following equipment.
   a) Incoming lines:110KV, 50 Hz, Two

   b) Outgoing lines: 110KV, 50 Hz, One
      66KV, 50 Hz, One
      11KV, 50 Hz, One

   c) Transformers: 15MVA, 110/66 KV, 3 phase, Y/Δ, Two
      10MVA, 110/11 KV, 3 phase, Y/Y, One
      3MVA, 11/400 KV, 3 phase, Y/Y, One

   d) Bus Bars: 110KV, Two
      66 KV, One
      11 KV, One
      400 KV, One

   Show the positions of CT, PT, Isolating Switches, Lightning arrestors, circuit breakers.

(20 marks)

Part B

3. Draw the suitable scale:

   a) End view with quarter half in section

   b) Front elevation with top half in section

   With following main dimensions of a commutator used for dc machine.

   Commutator dia = 83.5
   Length of commutator =86
   Length of riser = 10
   Width of the riser =5.1
   Thickness of mica = 1.25
   Shaft dia. = 29.2
   Segment pitch with mica = 5
   Outer dia of sleeve =78
   Height of segment = 19
   Sleeve is fixed by V ring & coller other missing data's may be proportionally assumed
   (All dimensions are in mm) (50 marks)

OR

4. Following are the details of 3 phase, core type transformer draw to suitable scale
   a) Front elevation of transformer assemble right half in section
   b) Plan of transformer assemble showing right half in section

   Core: Laminated steel plates of 0.35 mm
   Cross section of the core= 3 stepped core
   Diameter of circumscribing circle = 230 mm
   Overall Width = overall height of the core = 980 mm
   Window height = 470 mm

   Secondary winding (L.T):
   Number of turns =25
   Inside diameter & outside diameter are 250 mm and 271 mm respectively.
   Secondary conductor = 6 strips in parallel, 3 axially and 2 radially, each 9.5 mm x 3.2 mm
   Tape insulation = 0.5 mm

   Primary winding (H.T):
   Number of turns =750
   (8 coils of 83 turns each, arranged in 7 layers, height 37.5 mm, 2 coils of 43 turns each, height 23.5 mm)
   Inside diameter = 320 mm
   Outside diameter = 370 mm
   Primary conductor = 2.64 .mm, dia: 3 mm with insulation
   (50 marks)

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10EE661

Sixth Semester B.E. Degree Examination, June/July 2013

Operations Research

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What is OR? Discuss scientific method in OR. **(04 Marks)**

b. The manager of an oil refinery must decide on the optimal mix of two possible blending processes of which the input and output production runs are as follows:

Input		Output		
Process	Crude A	Crude B	Gasoline X	Gasoline Y
1	6	4	6	9
2	5	6	5	5

The maximum amounts available of crudes A and B are 250 units and 200 units respectively. Market demand shows that at least 150 units of gasoline X and 130 units of gasoline Y must be produced. The profits per production run from process 1 and process 2 are Rs.4 and Rs.5 respectively. Formulate the problem for maximizing the profit. **(06 Marks)**

c. Solve the given LPP by graphical method.

Maximize $Z = 2x_1 + 3x_2$

Subject to constraints, $x_1 + x_2 \le 30$

$x_2 \ge 3$

$x_2 \le 12$

$x_1 - x_2 \ge 0$

$x_1 \le 20$

$x_1, x_2 \ge 0.$ **(10 Marks)**

2 a. Solve the given LPP by simplex method.

Maximize $Z = 2x_1 + 5x_2$

Subject to constraints, $x_1 + 4x_2 \le 24$

$3x_1 + x_2 \le 21$

$x_1 + x_2 \le 9$

$x_1, x_2 \ge 0.$ **(08 Marks)**

b. Solve the following LPP:

Maximize $Z = x_1 + 2x_2 + 3x_3 - x_4$

Subject to constraints, $x_1 + 2x_2 + 3x_3 = 15$

$2x_1 + x_2 + 5x_3 = 20$

$x_1 + 2x_2 + x_3 + x_4 = 10$

$x_1, x_2, x_3, x_4 \ge 0$ **(12 Marks)**

3 a. Define slack and surplus variables. **(04 Marks)**

b. Solve the LPP by revised simplex method.

Maximize $Z = x_1 + 2x_2$

Subject to constraints, $x_1 + x_2 \leq 3$

$x_1 + 2x_2 \leq 5$

$3x_1 + x_2 \leq 6$ and $x_1, x_2 \geq 0$. **(08 Marks)**

c. Use dual simplex method to solve

Maximize $Z = 3x_1 + x_2$

Subject to constraints, $x_1 + x_2 \geq 1$

$2x_1 + 3x_2 \geq 2$

$x_1, x_2 \geq 0$. **(08 Marks)**

4 a. Write the dual of the following LPP:

Maximize, $Z = 3x_1 + 4x_2$

Subject to constraints, $2x_1 + 6x_2 \leq 16$

$5x_1 + 2x_2 \geq 20$

$x_1, x_2 \geq 0$. **(04 Marks)**

b. Solve the traveling salesman problem given by the following data:

$C_{12} = 20$, $C_{13} = 4$, $C_{14} = 10$, $C_{23} = 5$, $C_{34} = 6$,

$C_{25} = 10$, $C_{35} = 6$, $C_{45} = 20$ where $C_{ij} = C_{ji}$

and there is no route between cities i and j if the value for C_{ij} is not shown. **(10 Marks)**

c. Five wagons are available at stations 1, 2, 3, 4 and 5. These are required at five stations I, II, III, IV and V. The mileages between various stations are given by the table below. How should the wagons be transported so as to minimize the total mileage covered? **(06 Marks)**

	I	II	III	IV	V
1	10	5	9	18	11
2	13	9	6	12	14
3	3	2	4	4	5
4	18	9	12	17	15
5	11	6	14	19	10

PART – B

5 a. Determine initial basic feasible solution by Vogel's method. **(06 Marks)**

	1	2	3	4	Production Capacity
A	4	6	8	13	50
B	13	11	10	8	70
C	14	4	10	13	30
D	9	11	13	8	50
Demand	25	35	105	20	

b. Determine the initial basic solution by least cost entry method and obtain optimal solution.

	A	B	C	Available
I	50	30	220	1
II	90	45	170	3
III	250	200	50	4
Required	4	2	2	

(14 Marks)

6 a. Define:
i) Saddle point
ii) Pay-off matrix,
iii) Optimal strategy
iv) Two person zero sum game **(08 Marks)**

b. Solve graphically the following game theory: **(12 Marks)**

		B		
A		1	3	11
		8	5	2

7 a. Construct a network diagram for a project comprising of activities B, C, E, F, G, H, I, J, L, M, N, P and Q such that following constraints are satisfied:
B < E, F; C, F < G; C < L; E, G < H; H, L < J;
L < M; H, M < N; I, J < P; N < Q. **(08 Marks)**

b. A project consists of eight activities with the following relevant information:

Activity	Immediate Predecessor	Estimated Duration		
		t_o	t_m	t_p
A	-	1	1	7
B	-	1	4	7
C	-	2	2	8
D	A	1	1	1
E	B	2	5	14
F	C	2	5	8
G	D, E	3	6	15
H	F, G	1	2	3

Draw the PERT network and find out the expected project completion time.
What duration will have 95% confidence for project completion?
(For standard normal z = 1.645, area under the standard normal curve from o to z is 0.45)
(12 Marks)

8 a. What is the replacement policy when value of money changes with time? **(06 Marks)**

b. A computer contains 10000 resistors. When a resistor fails it is replaced. The cost of replacing a resistor individually is Re.1/-. If all the resistors are at the same time the cost/resistor is reduced by 65 paise the probability of serving at the end of the month is given below. What is the optimum replacement plan?

Month	0	1	2	3	4	5	6
Probability of Survival	1	0.97	0.9	0.7	0.3	0.15	0

(14 Marks)

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