

2012 - 2013
 B.TECH. AUTUMN (V SEMESTER) EXAMINATION
 (OPEN ELECTIVE)
 (ELECTRICAL / MECHANICAL / CIVIL / ELECTRONICS / COMPUTER /
 CHEMICAL / PETRO-CHEMICAL / ARCHITECTURE)

NUMERICAL TECHNIQUES

(AM - 351)

Credits: 04

Maximum Marks : 60

Duration : Three Hours

Note: Answer all the questions.

Programmable calculators are not allowed.

Write the answers to four decimals.

1. (a) Solve the system of equations $Ax = b$, where

$$A = \begin{bmatrix} 2 & 1 & 1 & -2 \\ 4 & 0 & 2 & 1 \\ 3 & 2 & 2 & 0 \\ 1 & 3 & 2 & -1 \end{bmatrix}, \quad b = \begin{bmatrix} -10 \\ 8 \\ 7 \\ -5 \end{bmatrix}, \quad x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}$$

Using the Gauss-elimination method with partial pivoting.

- (b) Compute singular value decomposition (SVD) of the matrix:

$$A = \begin{bmatrix} 4 & 0 \\ 3 & -5 \end{bmatrix}$$

- (c) Find A^{10} , when $A = \begin{bmatrix} 2 & 2 \\ 2 & -1 \end{bmatrix}$ exactly.

OR

- (c) Transform the matrix

$$A = \begin{bmatrix} 1 & 2 & 4 \\ 2 & 1 & 2 \\ 4 & 2 & 1 \end{bmatrix}$$

[5+5+5]

to tridiagonal form by Given's method. Obtain the intervals of unit length, each containing one eigen value of A . Hence find the largest eigenvalue correct to two decimal places using Newton-Raphson method.

2. (a) Determine the uniform step size that can be used in the tabulation of $f(x) = \cos 2x$ in the interval $\left[0, \frac{\pi}{4}\right]$ so that the truncation error of the cubic interpolation is less than 10^{-6} .

Contd.....2

- (b) (i) Find values of a and b such that the function:

$$f(x) = \begin{cases} ax^2 - x + 1 & , & 1 \leq x \leq 2 \\ 3x - b & , & 2 \leq x \leq 3 \end{cases}$$

is a quadratic spline.

- (ii) Obtain a cubic spline approximation valid in $[3, 4]$, for the function given in tabular form

$x :$	1	2	3	4
$f(x) :$	3	10	29	65

under the natural spline conditions

$$M(1) = 0 = M(4).$$

- (c) Determine the piece wise quadratic fit $P(x)$ to $f(x) = (1+x^2)^{\frac{1}{2}}$ with nodes at $-1, -\frac{1}{2}, 0, \frac{1}{2}, 1$.

OR

- (c') Obtain a rational approximation of the form $R_{2,3}(x)$ to $\sin x$. Also find the order [4+6+5] of its approximation.

3. (a) For the function $f(x) = 3 + e^{-\frac{x}{\pi}}$ on the interval $[0, \pi]$, determine the L_1, L_2 and L_∞ norms with respect to weight function $w(x) = x$.
- (b) Obtain a least squares polynomial approximation of degree two for $f(x) = x^3$ on the interval $[0, 1]$ with $w(x) = 1$.

OR

- (b') For the following data :

x	0	0.5	1	2
$f(x)$	1	3.52	3.73	-1.27

Compute the values of a, b and the natural number n such that the sum

$$\sum_{i=1}^4 [f(x_i) - a \sin(nx_i) - b]^2$$

is minimized.

- (c) Determine as accurately as possible a straight line $y = ax + b$ approximating $1/x^2$ [5+5+5] is the Chebyshev sense on $[1, 2]$. Calculate a and b to two correct decimals.

Contd.....3

4. (a) A snack food manufacturer markets two kinds of mixed nuts, labelled A & B. Mixed nuts A contains 20% almonds, 10% cashew nuts, 15% walnuts and 55% peanuts. Mixed B contains 10% almonds, 20% cashew nuts 25% walnuts and 45% peanuts. A customer wants to use mixed nuts A and B to prepare a new mix that contains at least 4lb of almonds, 5lb cashew nuts, 6lb of walnuts, for a party. If mixed nuts A and B cost \$2.50 and \$3.00 per pound, respectively. Determine the amounts of mixed nuts A and B to be used to prepare the new mix at a minimum cost.

- (b) Write the dual problem of the following LPP.

$$\begin{array}{ll} \text{Minimize} & P = 15x_1 + 12x_2 \\ \text{Subject to} & x_1 + 2x_2 \geq 3 \\ & 2x_1 - 4x_2 \leq 5 \\ & x_1, x_2 \geq 0. \end{array}$$

- (c) Use simplex method to solve the LPP:

$$\begin{array}{ll} \text{Minimize} & P = 4x_1 + x_2 \\ \text{Subject to} & 3x_1 + x_2 = 3 \\ & 4x_1 + 3x_2 \geq 6 \\ & x_1 + 2x_2 \leq 4 \\ & x_1, x_2 \geq 0. \end{array}$$

[5-3+7]

2012-2013

B.TECH. AUTUMN (V SEMESTER) EXAMINATION

(OPEN ELECTIVE)

(ELECTRICAL/CIVIL/MECHANICAL/ELECTRONICS/COMPUTER/CHEMICAL/PETRO-CHEMICAL & ARCHITECTURE ENGG.)

ENGINEERING MATERIALS & MATERIAL SCIENCE

(AP-308)

Credits:4

Maximum Marks : 60

Duration : Three Hours

Note : Answer ALL questions. The symbols have their usual meaning.

1. (a) What do you mean by static dielectric constant and distinguish between the solids according to dielectric behavior? 5.0
- (b) Define internal field in dielectrics and show that $E_{i, \text{Lorentz}} = E + P/3\epsilon_0$, where E is the applied field and P is the dipole moment per unit volume. 5.0

OR

- (b') Define orientational polarization (P_o) and show that $P_o = N\mu_p^2 E/3kT$ for polyatomic gases. 2.0
- (c) What is ferroelectricity? Give three examples of ferroelectric materials. 2.0
- (d) The electronic polarizability of the Ar atom is $1.7 \times 10^{-40} \text{ F m}^2$. What is the static dielectric constant of solid Ar (an FCC crystal below 84 K) if its density is 1.8 g/cm^3 ? Given $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$ and Relative atomic mass of Ar = 39.95 g/mol 3.0

2. (a) Explain the frequency dependence of electronic polarizability in detail. Plot the real and imaginary parts of the polarizability with frequency of an atom. 7.0
- (b) Define *loss-tangent*. Show that absorption of energy per m^3 is given by $W(t) = (\omega/2) \epsilon'' E_o^2$ 5.0
- (c) Establish the Einstein relation $D/\mu = kT/q$. 3.0

OR

- (c) Boron is implanted into an n-type Si sample ($N_D = 10^{16} \text{ cm}^{-3}$), forming an abrupt junction of square cross section, with area = $2 \times 10^{-3} \text{ cm}^2$. Assume that the acceptor concentration in the p-type region is $N_A = 4 \times 10^{18} \text{ cm}^{-3}$. Calculate V_o and \mathcal{E}_c for this junction at equilibrium (300K). Given $\epsilon_r = 11.8$, $n_i = 1.5 \times 10^{10} \text{ cm}^{-3}$ and $k = 8.617 \times 10^{-5} \text{ eV/K}$.
- 3.(a) Draw and explain B/H curve of a ferromagnetic system. Define spontaneous magnetization. 5.0
- (b) A paramagnetic system is subjected to a homogeneous field of 10^6 A/m at a temperature of 300K. Find the average dipole moment along the field direction per atom in Bohr magneton. 5.0
- (c) Discuss antiferromagnetism. Establish a relation between Neel temperature and paramagnetic Curie temperature. What are your comments on this relation? 5.0

OR

- (c) Write a note on ferrites.
- 4.(a) Differentiate between a perfect conductor and a superconductor. Give following graphical representations alongwith their mathematical relations λ_L vs T, n_s vs T and H_c vs T 5.0
- (b) What is Josephson effect? Show that the current flowing across the Josephson junction is given by $I = I_o \sin \delta$ under no biasing. 7.5
- (c) List five high temperature superconductors. 2.5

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B. TECH. AUTUMN (V SEMESTER) EXAMINATION
(Electrical/Mechanical/Electronics/Computer/Civil/Chemical)
(Power Electronics & Applications)
EE-301(Open Elective)

Maximum Marks: 60**Credits:04****Duration: Three Hours**

Instruction to the Examinees:

*Answer all the questions. Notations used have their usual meaning.**Assume suitable value for any missing data.**Use graph paper or waveform exercise sheets to show waveforms.**Discuss*

- Q.1 (a) Give the differences between the following with the help of static V-I Characteristics:
 (i) TRIAC & IGBT (ii) DIODE & SCR [6]
- (b) Describe reverse recovery characteristics of a power diode. Show that reverse recovery time and peak inverse current are dependent upon storage charge and rate of change of current. [6]
- OR
- Q.1' (a) Discuss in details:
 (i) di/dt limitations & (ii) dv/dt limitations of a Thyristor. [6]
- (b) Discuss the classifications of Power Electronics Converters. Also mention their important applications. [6]
- Q.2 (a) What are the necessary conditions for turning-on of an SCR with a gate signal? Discuss. [6]
- (b) Explain the merits and demerits of self commutation of SCR and its other method of commutation. [6]
- Q.3 (a) Draw and explain the wave shapes of supply voltage, output voltage, load current, current through SCR, current through freewheeling diode and voltage drop across SCR of a single phase semi-converter controlled rectifier feeding an RLE load for a switching angle, $\alpha = 60^\circ$. [8]
- (b) What is the principle of ac phase control, explain? [4]
- OR
- Q.3' (a) Define the following terms:
 (i) Ripple Factor (ii) Form Factor (iii) THD (iv) Displacement Factor
 (v) Efficiency of Rectification & (vi) Transformer Utilization Factor as applicable to rectifier circuits. [6]

- (b) Draw the circuit diagram and explain the working of a three phase dual converter. [6]
- Q.4 (a) With the help of waveforms, explain both Continuous and Discontinuous conduction mode of STEP-UP (BOOST) Converter. Also mention their important applications. [8]
- (b) For type-A Chopper, dc source voltage is 230V. Load resistance is 10Ω . Take a voltage drop of 2 V across chopper when it is on. For a duty cycle of 0.4, calculate average and rms value of output voltage and chopper efficiency. [4]
- Q.5 (a) Describe the working of a single-phase half bridge inverter. What is its main drawback? Explain how this drawback is overcome. [6]
- (b) Enumerate industrial applications of:
(i) Cycloconverters and (ii) Inverters (both CSI & VSI) [6]
- OR
- (b') A single phase CSI is fed from 220 V dc source. The load is 10Ω . Thyristors have turn-off time of $20\mu s$ and inverter output frequency is 50Hz. Take the factor of safety of 2. Determine suitable value of source inductance assuming a maximum current change in one cycle. Also find the value of commutating capacitor. [6]

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(OPEN ELECTIVE)

(CIVIL / ARCHITECTURE / ELECTRICAL / ELECTRONICS / COMPUTER /
CHEMICAL / PETRO-CHEMICAL AND MECHANICAL ENGINEERING)

PUMPS, BLOWERS AND COMPRESSORS

(ME – 437)

Credits: 04

Maximum Marks : 60

Duration : Three Hours

- Note: (i) Assume any missing data if not given.
(ii) Draw diagrams where needed.

1. (a) Define slip. When slip will be negative? [02]
(b) A single acting reciprocating pump has a diameter of 30 cm and stroke 50 cm. It takes the supply of water from a sump 3.5 m below the pump axis through a pipe 10 m long 20 cm dia. If separation occurs at 2.5 m of water abs, Determine (i) speed at which separation may take place (ii) change in speed of pump if an air vessel is fitted on the suction side 2.5 m above the sump water level. Take $\lambda = 4f = 0.04$, Barometric head = 10.3 m of water. [10]

OR

- 1'. A single acting reciprocating pump has a stroke length of 15 cm the suction pipe is 7m long and the ratio of suction pipe diameter to the plunger diameter is $\frac{3}{4}$. The water level in the sump is 2.5m below the axis of the pump cylinder and the pipe connecting the sump and pump cylinder is 7.5 cm diameter. If the crank is running 75 rpm, determine the pressure head on the piston at the beginning, mid and end of the suction stroke. Take friction factor $\lambda = 4f = 0.04$. [12]

2. (a) Evolve head discharge curve of a centrifugal pump impeller and show that backward curved impeller is used in centrifugal pump generally. [04]
(b) A centrifugal pump has an impeller of 18 cm outer diameter and when running at 1440 rpm, discharges water $10 \text{ m}^3/\text{min}$ against a net head of 9m. The inner diameter of impeller is 9 cm, the blades are set back at outlet at 45° , area of flow is constant as 0.06 m^2 . Find manometric efficiency and blade angle at inlet. [08]

OR

- (b') A centrifugal pump has a delivery lift of 13m and suction lift of 2m. The velocity in the delivery pipe is 1.5 m/sec. The velocity of flow through the impeller is 3 m/sec and impeller blade angle at exit is 30° . Neglect losses. Find [08]

Contd.,....2

- (a) rim velocity of rotor,
- (b) pressure head at exit from rotor
- (c) velocity at exit from rotor
- (d) direction of fixed guide vane.

3. (a) What is hydraulic similitude? Why model testing is necessary before manufacturing. Give two reasons. [2+2]

(b) A hydraulic turbine is to develop 845 KW when running at 100 rpm under a net head of 10m. Work out the flow rate and specific speed for the turbine if the overall efficiency for best operating point is 92%. In order to predict the performance, a 1:10 scale model is tested under a head of 10 m. What would be the speed, power output and water consumption of the model if it runs under the condition similar to the proto types. [08]

4. (a) Derive the Eulers head for centrifugal blower. [04]

OR

(a') Define total and stagnation temperature and derive [04]

$$T_{01} = T_1 + \frac{V_1^2}{2C_p}$$

(b) Air at a pressure of 10.1325 N/m^2 and a temperature of 288K is compressed in a single stage turbo blower to $13.8 \times 10^4 \text{ N/m}^2$. Calculate the work done per kg of air if the compression follows the law $p v^{1.6} = \text{const}$. Take $C_p = 1200 \text{ J/KgK}$. If the volume of free air compressed / min by the blower is 1020 m^3 , determine power required to drive the blower and the adiabatic efficiency. [08]

5. (a) What do you mean by surging choking and stalling? Explain briefly. [04]

(b) An axial flow compressor having eight stages and 50 reaction design compresses air in the pressure ratio of 4:1. The air enters the compressor at 20°C and flows through it with a constant speed of 90 m/sec. The rotating blades of compressor rotate with 180 m/sec. Isentropic efficiency of the compressor may be taken as 82%. Calculate [08]

(i) Work done by the m/c.

(ii) Blade angles.

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ATMOSPHERIC CHEMISTRY

(AC – 308)

Credits: 04

(OPEN ELECTIVE)

Maximum Marks : 60

Duration : Three Hours

Note: Answer all questions.

1. (a) What is atmosphere? Give the composition of atmosphere. [04]
(b) Discuss the energy balance in the atmosphere. [06]
2. (a) What is photochemical smog? Explain $\text{NO} - \text{NO}_2 - \text{O}_3$ photochemical reaction sequence with the help of diagram. [05]
(b) Write short notes on any TWO of the following: [05]
 - (i) Methanol as alternative fuel.
 - (ii) Nitrogen Cycle.
 - (iii) Absorption of electromagnetic radiation by molecule.
3. (a) What are criteria pollutants? Discuss the sources and physiological effects of carbon monoxide. [06]
(b) What is the significance of PM_{10} and $\text{PM}_{2.5}$? Explain how human respiratory system defends itself against the invasion of particulates. [04]
4. (a) Name the various methods used to control air pollutants. What is diffusion method? [05]
(b) Describe the working of electrostatic precipitator. [05]
5. (a) Name various methods for sampling gaseous pollutants. Discuss the principle and significance of condensation process. [04]
(b) Write notes on any TWO of the following: [3×2]
 - (i) Ethylene blue method for the determination of H_2S .
 - (ii) Hapcolite monitor of CO.
 - (iii) Acid titration method for SO_2 .
6. (a) Describe green house effect. [03]
(b) Write the catalytic reaction for the destruction of stratospheric ozone with chlorine and Bromine. [03]
(c) Draw a labelled diagram of Action spectra for damage to plants, DWA and human skin. [02]
(d) What are the sources of methyl bromide (CH_3Br) in catalytic destruction of stratospheric ozone? [02]