## SYLLABI FOR FIVE & HALF YEAR INTEGRATED BACHELOR OF ENGINEERING (CHEMICAL WITH M.B.A.)
### EXAMINATIONS 2017-2018
### SCHEME OF TEACHING AND EXAMINATION

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<tr>
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### Total Contact hours/week
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**Note:**
- NSS/NCC/Sports proficiency/Community services/ Professional society activities/Technical Activities related to the field of Engineering (1st to 3rd year, 2 credits to be earned in 7th semester)
- Discipline (1st to 4th year, 1 credit to be earned in 8th semester)

L: Lectures/Week, T: Tutorials/Week, P: Practical Hours/Week

**Note:** Mid Term marks includes: Evaluation towards one best out of two minor tests (50% of Mid-term marks), Assignments (20% of the Mid-term marks), Class surprise tests / quizzes / presentations / term paper (20% of Mid-term marks) and class attendance (10% of Mid-term marks).

BSC: Basic engineering course  
ESC: Engineering Sciences  
CHE: Chemical Engineering Core Courses  
CHO: Open Electives  
HSSC: Humanities and Social Sciences Course  
CHM: Management Core Courses
# SYLLABI FOR FIVE & HALF YEAR INTEGRATED BACHELOR OF ENGINEERING (CHEMICAL WITH M.B.A.) EXAMINATIONS 2017-2018

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**Total Contact hours/week** 26

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- NSS/NCC/Sports proficiency/Community services/ Professional society activities/Technical Activities related to the field of Engineering (1st to 3rd year, 2 credits to be earned in 7th semester)
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ESC: Engineering Sciences
CHE: Chemical Engineering Core Courses
CHO: Open Electives
HSSC: Humanities and Social Sciences Course
CHM: Management Core Courses
## SEMESTER-3RD

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### Note:

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#### EXAMINATIONS 2017-2018

#### SCHEME OF TEACHING AND EXAMINATION

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**Note:**

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- Discipline (1\textsuperscript{st} to 4\textsuperscript{th} year, 1 credit to be earned in 8\textsuperscript{th} semester)
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**Total Contact hours/week:** 32

**Note:**

- Sports proficiency/Community services/ Professional society activities/Technical Activities related to the field of Engineering (1st to 3rd year, 2 credits to be earned in 7th semester)

- Discipline (1st to 4th year, 1 credit to be earned in 8th semester)
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**Total Contact hours/week**

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**Note:**

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**Note:**

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## SEMESTER-8th

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<td>T</td>
<td>P</td>
<td>C</td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>CHE 401</td>
<td>Transport phenomena</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>35</td>
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<tr>
<td>2</td>
<td>CHE 402</td>
<td>Environment Engineering</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>CHE 403</td>
<td>Process Modelling and Simulation</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>CHE 406</td>
<td>Project Work</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>CHE 409</td>
<td>Comprehensive Viva</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
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<tr>
<td>6</td>
<td>CHO 403</td>
<td>Open Elective-III</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
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<tr>
<td>7</td>
<td>CHD 402</td>
<td>Department Elective-III</td>
<td>3</td>
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<td>-</td>
<td>50</td>
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<tr>
<td>8</td>
<td>CHM 402</td>
<td>Financial Accounting</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>9</td>
<td>CHM 403</td>
<td>Business Environment</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>18</td>
<td>4</td>
<td>8</td>
<td>27</td>
<td>50</td>
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</tr>
</tbody>
</table>

**Total Contact hours/week** | 30

*‘S’ (Satisfactory) or ‘X’ (Repeat)*

**Note:**

- Discipline (1st to 4th year, 1 credit to be earned in 8th semester)
<table>
<thead>
<tr>
<th>S No.</th>
<th>List of Departmental Electives</th>
<th>S. No</th>
<th>List of Open Electives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Petroleum Processing Engineering</td>
<td>1.</td>
<td>Production and Operations Management</td>
</tr>
<tr>
<td>2</td>
<td>Process Instrumentation</td>
<td>2.</td>
<td>Fuel Cell Technology</td>
</tr>
<tr>
<td>3</td>
<td>Industrial Safety and Hazards</td>
<td>3.</td>
<td>Macroeconomics</td>
</tr>
<tr>
<td>4</td>
<td>Plant Utilities</td>
<td>4.</td>
<td>International Business Management</td>
</tr>
<tr>
<td>5</td>
<td>Petrochemical Technology</td>
<td>5.</td>
<td>Total Quality Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.</td>
<td>Nanotechnology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.</td>
<td>Polymer Science and Engineering</td>
</tr>
</tbody>
</table>
### SCHEME OF TEACHING AND EXAMINATION (2017-2018)

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
<th>Teaching Hrs. per Week</th>
<th>End Term</th>
<th>Mid Term</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L  T  P  C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NINTH SEMESTER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MBA-CHE 5901</td>
<td>Financial Management</td>
<td>4  -  -  4</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>MBA-CHE 5902</td>
<td>Functional Subject-1</td>
<td>4  -  -  4</td>
<td>50</td>
<td>50</td>
<td>100</td>
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<tr>
<td>MBA-CHE 5903</td>
<td>Functional Subject-2</td>
<td>4  -  -  4</td>
<td>50</td>
<td>50</td>
<td>100</td>
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<tr>
<td>MBA-CHE 5904</td>
<td>Functional Subject-3</td>
<td>4  -  -  4</td>
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<td>50</td>
<td>100</td>
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<tr>
<td>MBA-CHE 5905</td>
<td>Functional Subject-4</td>
<td>4  -  -  4</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

**Practicals**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
<th>Teaching Hrs. per Week</th>
<th>End Term</th>
<th>Mid Term</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA-CHE 5951</td>
<td>Workshop on Soft Skills</td>
<td>-  -  2  1</td>
<td>-</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>MBA-CHE 5952</td>
<td>Workshop on Developing</td>
<td>-  -  2  1</td>
<td>-</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>MBA-CHE 5953</td>
<td>Entrepreneurial Skills</td>
<td>-  -  -  -</td>
<td>25</td>
<td>-</td>
<td>25</td>
</tr>
<tr>
<td>MBA-CHE 51053</td>
<td>Summer Training</td>
<td>-  -  2  -</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Total**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>20</td>
<td>6</td>
<td>22</td>
<td>275</td>
<td>300</td>
</tr>
</tbody>
</table>

**Group-A (Functional Subject-1 & 2)**

1. Marketing Research and Consumer Behavior
2. Investment Analysis and Portfolio Management
3. International Human Resource Management
4. Supply Chain Management

**Group-B (Functional Subject-3 & 4)**

1. Advertising and Sales Management
2. Strategic Cost Management
3. Organizational Development
4. Enterprise Resource Planning

Students in the ninth semester will have to opt for FOUR functional subjects, selecting TWO each from Group A & B.
### TENTH SEMESTER

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
<th>Teaching Hrs. per Week</th>
<th>End Term</th>
<th>Mid Term</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA-CHE 51001</td>
<td>Strategic Management</td>
<td>L 4 T 4 P 4</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>MBA-CHE 51002</td>
<td>Business Environment</td>
<td>L 4 T 4 P 4</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>MBA-CHE 51003</td>
<td>Production and Operation Management</td>
<td>L 4 T 4 P 4</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>MBA-CHE 51004</td>
<td>Intellectual property rights</td>
<td>L 4 T 4 P 4</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>MBA-CHE 51005</td>
<td>Functional Subject-5</td>
<td>L 4 T 4 P 4</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>MBA-CHE 51006</td>
<td>Functional Subject-6</td>
<td>L 4 T 4 P 4</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

### Practicals

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
<th>Teaching Hrs. per Week</th>
<th>End Term</th>
<th>Mid Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA-CHE 51051</td>
<td>Seminar on Corporate Governance</td>
<td>- 2 NC</td>
<td>-</td>
<td>Qualifying</td>
</tr>
<tr>
<td>MBA-CHE 51052</td>
<td>Workshop on Information Technology and Systems</td>
<td>- 2 1</td>
<td>-</td>
<td>25</td>
</tr>
<tr>
<td>MBA-CHE 51053</td>
<td>Research Project</td>
<td>- 2 2</td>
<td>-</td>
<td>‘S’ or ‘X’</td>
</tr>
<tr>
<td>MBA-CHE 51054</td>
<td>*Comprehensive Viva-Voce-III</td>
<td>- 2 2</td>
<td>50</td>
<td>-</td>
</tr>
</tbody>
</table>

**Total** 24 - 6 29 350 325 675

### Functional Subject-5

1. International Business Management
2. International Financial Management
3. Industrial Relations and Labour Laws
4. Advanced Production Management

### Functional Subject-6

1. Industrial and Rural Marketing
2. Management of Financial Services
3. Performance Management
4. Productivity Management

Students in the tenth semester will have to opt for TWO functional subjects, selecting ONE each from Functional Subject-5 & 6 above.

*The Comprehensive Viva-Voce-III examination (Paper MBA-CHE 51054) will cover the subjects taught during the 9th and 10th Semesters.*
### 5½ Integrated B.E. (Chemical) with M.B.A. Dual Degree Course [2017-2018]

**FIRST YEAR**

#### 1st SEMESTER

<table>
<thead>
<tr>
<th>Title</th>
<th>MATHEMATICS-I</th>
<th>Credits</th>
<th>04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>BSC 101</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester</td>
<td>1™</td>
<td>L T P</td>
<td>3 1 -</td>
</tr>
<tr>
<td>Max.Marks</td>
<td>End term-50</td>
<td>Mid term-50</td>
<td>Practical --</td>
</tr>
<tr>
<td>Pre requisites</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact Hours</td>
<td></td>
<td></td>
<td>42 Hours</td>
</tr>
</tbody>
</table>

#### THEORY

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Time</th>
<th>3 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>To make the students understand the behaviour of infinite series and their use.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Understand the concepts related to functions of several variables and their applications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Understand the concept of Vectors and its applications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Learn the methods of evaluating multiple integrals and their applications to various problems.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Learn the methods to formulate and solve linear differential equations and apply them to solve engineering problems.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Note for the Examiner

The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.

#### SECTION- A

<table>
<thead>
<tr>
<th>Infinite Series:</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infinite series and convergence, alternating series, power series and convergence. Taylor’s and Maclaurin’s Series.</td>
<td>06</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multivariable Functions:</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit, Continuity and Partial Derivatives; Euler’s Theorem for Homogeneous functions; Differentiability, Linearization and Differentials; Chain rule; Extreme values and Saddle Points; Lagrange multipliers; Taylor’s Formula.</td>
<td>08</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vectors:</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradient, Divergence, Curl, Statement of Green’s, Gauss and Stoke’s Theorem and their simple applications.</td>
<td>06</td>
</tr>
</tbody>
</table>

#### SECTION- B

<table>
<thead>
<tr>
<th>Solid Geometry:</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinders and Cones, Cylindrical and Spherical Polar Coordinates</td>
<td>04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Integral Calculus:</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area between plane curves; Volumes of solids of revolution; Lengths of plane curves; Areas of surfaces of revolution. Double integrals in rectangular and Polar form, Triple integrals in Rectangular, Cylindrical and Spherical coordinates, Substitutions in Multiple Integrals.</td>
<td>08</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ordinary Differential Equations:</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>First order exact differential equations, Integrating factor, Orthogonal trajectories, Second and Higher order Linear Differential Equations with constant coefficients, Differential Operators, Methods of Variation of Parameters and Undetermined Coefficients, Euler Cauchy Equation, Wronskian.</td>
<td>10</td>
</tr>
</tbody>
</table>

#### Text books:


#### Reference Books:

Course Assessment Methods

Assessment will consist of the following components:
1. Mid-Term
   a. One best of two minor tests (50% of Mid-term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance. (10% of Mid-term marks)

2. End-Term

Course Outcomes

The students are able to:
1. test the behaviour of infinite series.
2. analyze functions of several variables and their applications.
3. operate vectors and convert line integral to surface integral to volume integral.
4. evaluate multiple integrals and apply them to practical problems.
5. solve linear differential equations.

Title | Applied Physics (Condensed Matter) | Credits | 4
Code | BSC 104 | Semester:- 1st | L T P | 2 1 2
Max marks | End Term-40 | Mid Term-35 | Practical-25 | Contact hours | 28 (Theory) 14 (Practical Sessions)
Pre-requisites | Elective | N

Theory | Time | 3 hours

Objectives
To make the students understand
- the importance of the structural properties of materials and engineering their properties.
- the engineering of semiconducting, magnetic and nano-materials and utilize the concept studied for developing various applications.

Note for examiner
The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.

SECTIONS

SECTION A | Hrs
Crystal structure: Space lattices and their symmetries, crystal structures (cubic and hexagonal cells), assignment of coordinates, directions and planes in crystals, linear, planer and space densities in crystals, close packed morphology (Hexagonal and cubic close packing), single and polycrystalline structures, interstitial spaces (trigonal, tetrahedral and octahedral voids, crystal Structure analysis, X-ray diffraction and Bragg’s law, crystal defects, Point, line, surface and volume imperfections | 10
Theory of Metals: Free electron theory, electrical properties, thermal properties, motion in magnetic field (cyclotron resonance), Zone theory. Band theory of solids, Kronig-Penney Model (qualitative), conductors, insulators and semiconductors | 6
Dielectric Materials: Review of basic formulas, dielectric constant and polarizability, sources of polarizability, classical treatment of dipolar, ionic and electronic polarizability, piezoelectricity, ferroelectricity. | 5

SECTION B | Hrs
Magnetic Materials: Review of basic formulas, magnetic susceptibility, classification of materials, Langevin diamagnetism, paramagnetism (only classical treatment), magnetism in metals, ferromagnetism in insulators, anti-ferromagnetism and ferrimagnetism, ferromagnetism in metals, ferromagnetic domains, hysteresis | 8
Superconductivity: Zero resistance, occurrence of superconductivity, Meissner effect, critical field, thermodynamics of superconducting transitions, electrodynamics of superconductors, qualitative idea of BCS theory. | 4
Semiconductors: p-type and n-type semiconductors, statistics of electrons and holes, Hall effect (for single as well as both type of charge carriers) | 4
Nanotechnology: Introduction, Synthesis of Nanoparticles: Mechanical Method, Sputtering, | 5
| Chemical Vapour Deposition, Sol-gel Technique, Applications of Nanotechnology |
|---|---|

**Text Books**  
1. Introduction to Solid State Physics: Charles Kittle 8th Ed.  
2. Elements of X-ray Diffraction, B.D. Cullity

**Reference Books**  
c. Solid State Physics (New Age Publishers) – S.O. Pillai  

**Course Assessment Methods**  
Assessment will consist of the following components  
1. Mid-Term  
   a. One best of two minor tests (50% of Mid-term marks)  
   b. Assignments (20% of Mid-term marks)  
   c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)  
   d. Attendance. (10% of Mid-term marks)  
2. End-Term

**Course Outcomes**  
Students are able to  
- analyze the crystal structure of materials along with the knowledge of XRD technique.  
- understand the electrical, thermal and dielectric properties of materials.  
- understand magnetic properties of materials with the knowledge of superconductor and semiconductors and are in a position to synthesize and understand the engineering of nano-materials.

**Applied Physics (Condensed Matter) Practical**

**Objectives**  
To make student understand the theories technically by performing and developing the respective experiments.

**Practical session wise break-up**

<table>
<thead>
<tr>
<th>Practical session</th>
<th>No. of sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>To find the energy band gap of the given semiconductor by four probe method.</td>
<td>4*</td>
</tr>
<tr>
<td>To study the Hall Effect of a given semiconductor</td>
<td>2</td>
</tr>
<tr>
<td>To determine the dielectric constant of the given materials.</td>
<td>2</td>
</tr>
<tr>
<td>To study the B-H curve of the ferromagnetic materials.</td>
<td>2</td>
</tr>
<tr>
<td>To determine the value of e/m for electron by long solenoid (helical) method.</td>
<td>2</td>
</tr>
<tr>
<td>To study the variation of magnetic field with distance along the axis of a circular coil carrying current by plotting a graph</td>
<td>2</td>
</tr>
</tbody>
</table>

**Text Books**  
1. Practical Physics by CL Arora, S Chand & Co.  
2. Engineering physics by S.K. Srivastva

**Reference Books**  
A text book of practical physics by William & Watson

**Course Assessment Methods**  
One *project out of 6 carries 40% marks, 20% for respective viva and 20% for external exams and 10% for attendance.

**Course outcomes**  
The student will gain  
- Proficiency in technical aspects of performing the experiments.  
- Proficiency in designing scientific projects

<table>
<thead>
<tr>
<th>Title</th>
<th>Communication Skills (Advance)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>HSSC 102</td>
<td>Semester:-1st</td>
</tr>
<tr>
<td>Max marks</td>
<td>End Term-15</td>
<td>Mid Term-10</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theory</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Objectives**

1. To inculcate effective communication skills in students for better performance in professional as well as personal life
2. To improve personality of students with advanced techniques in verbal, non verbal and para verbal communication.

**Note for examiner**

The semester question paper of the subject will be of 15 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.

<table>
<thead>
<tr>
<th>SECTION A</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Communication Skills</td>
<td>2</td>
</tr>
<tr>
<td>Speaking Skills</td>
<td>3</td>
</tr>
<tr>
<td>Interpersonal Communication, Presentation Skills, Voice Modulation, Persuasion, Negotiation and Linguistic Programming, Public Speaking, Group Discussions, Interviews and Case Studies, Conducting Meetings and Conferences</td>
<td></td>
</tr>
<tr>
<td>Personality Development</td>
<td>2</td>
</tr>
<tr>
<td>Body Language and importance of Non Verbal communication, Social and Professional etiquettes.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECTION B</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication and Media</td>
<td>1</td>
</tr>
<tr>
<td>Social and Political Context of Communication, Recent Developments in Media</td>
<td></td>
</tr>
<tr>
<td>Advanced Techniques in Speaking Skills</td>
<td>2</td>
</tr>
<tr>
<td>Importance of Listening/Responding to native and global accents, Telephonic Interviews and Video Conferencing</td>
<td></td>
</tr>
<tr>
<td>Advanced Techniques in Technical Writing</td>
<td>4</td>
</tr>
<tr>
<td>Job Application, CV Writing, Business Letters, Memos, Minutes, Reports and Report Writing Strategies, E-mail Etiquette, Blog Writing, Instruction Manuals and Technical Proposals</td>
<td></td>
</tr>
</tbody>
</table>

**Text Books**


**Reference Books**


**Course Assessment Methods**

Assessment will consist of the following components

1. Mid-Term
   a. One best of two minor tests (50% of Mid-term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance. (10% of Mid-term marks)
2. End Term

**Course Outcomes**

1. Gain proficiency in English language as medium for communication in both professional and personal life
2. Increase in employment prospective of students by developing technical aspects of communication.
3. Personality development of students by thorough knowledge of effective and enhanced communication skills
### Communication Skills (Advance) Practical

#### Objectives
1. To develop better pronunciation and communication skills.
2. To be able to face interviews and participate in conferences or any personal or professional discussions with confidence.
3. To develop technical writing skills.
4. To be able to articulate one's voice and overcome stage fright.

#### Practical session wise break-up

<table>
<thead>
<tr>
<th>Organizational Communication</th>
<th>No. of sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal and Non-Verbal Communication at different levels of organization, Role Play, Interaction with Bosses and Co-employees</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speaking Techniques</th>
<th>No. of sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation of Interviews, Participation in Group Discussions and Case Studies, Making and Presenting Power Point Lectures.</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Advanced Speaking Techniques</th>
<th>No. of sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conducting Meetings and Conferences, Exposure to different Accents, Listening and responding in the global scenario, Telephonic Interviews/Conversations, Video Conferencing</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical Writing</th>
<th>No. of sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing Letters, Memos, Minutes, Notes, CV, Job Applications, Reports and e-mails, Preparing Instruction Manuals and Technical Proposals</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. English Speaking skills of students will be enhanced.</td>
</tr>
<tr>
<td>2. Students will become self confident in handling both professional and personal meetings/discussions.</td>
</tr>
<tr>
<td>3. Students will be able to demonstrate improved technical writing skills.</td>
</tr>
<tr>
<td>4. Overall personality of students as well as their communication skills will be developed.</td>
</tr>
</tbody>
</table>

### Introduction to Environmental Science

<table>
<thead>
<tr>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Environmental Science</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Code</th>
<th>Max marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESC 106</td>
<td>Semester-1st</td>
<td>End term- 40 Mid term- 35 Practical - Elective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>L T P</th>
<th>End term-</th>
<th>Mid term-</th>
<th>Practical -</th>
<th>Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 -</td>
<td>35</td>
<td>-</td>
<td>-</td>
<td>N</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-requisites</th>
<th>Contact hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>42 Hours</td>
</tr>
</tbody>
</table>

#### THEORY

<table>
<thead>
<tr>
<th>Time</th>
<th>3 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>To recognize major concepts of environmental sciences and demonstrate in depth understanding of the environment.</td>
</tr>
<tr>
<td>To make the students to understand the need and importance of protection of environment.</td>
</tr>
<tr>
<td>To spread awareness regarding environmental issues and their impact on society</td>
</tr>
</tbody>
</table>

#### Note for examiner

The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.

### SECTION A

<table>
<thead>
<tr>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man and environment, environmental pollution, Ecosystem-structure and function of ecosystem, types of ecosystem, Introduction to biodiversity, International concern over environmental problems</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Air pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sources of air pollution, types of air pollutants, air quality, effects of air pollution, greenhouse effect, ozone layer depletion, smog and photochemical smog, acid rain-theory and effects.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Different types of water pollutants, effects of water pollution, pollution of receiving bodies, analysis of water pollution.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
</tr>
</tbody>
</table>
### SECTION B

<table>
<thead>
<tr>
<th>Topic</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil pollution</td>
<td>4</td>
</tr>
<tr>
<td>Components of soil, soil pollution, detrimental effects of pesticides and metal ions</td>
<td></td>
</tr>
<tr>
<td>Noise pollution</td>
<td>2</td>
</tr>
<tr>
<td>Classification of noise pollution, effects of noise pollution and control measures</td>
<td></td>
</tr>
<tr>
<td>Nuclear hazards, radiation pollution, solid waste- Introduction and case studies</td>
<td>3</td>
</tr>
<tr>
<td>Social issues and the environment, concept of sustainable development, rain water harvesting, watershed management, wasteland reclamation</td>
<td>6</td>
</tr>
<tr>
<td>Population and economic growth</td>
<td>2</td>
</tr>
<tr>
<td>Environmental ethics, laws relating to environment</td>
<td>4</td>
</tr>
</tbody>
</table>

### Text Books
2. A. Bhaskar,”Environmental Studies”, Pearson Publisher, 2011.

### Reference Books

### Course Assessment Methods
Assessment will consist of the following components
1. Mid-Term
   a. One best of two minor tests (50% of Mid-term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance. (10% of Mid-term marks)
2. End – Term

### Course Outcomes
The students are able to:
1. To identify environmental problems relating to the living organisms.
2. To analyse various risks associated with environmental problems and their remedial measures
3. To develop a sense of community responsibility by becoming aware of scientific issues in larger social context.

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**Title**  Electrical and Electronics Engineering  **Credits**  5

**Code**  ESC 103  **Semester:** 1st  **L T P**  3 1 3

**Max marks**
- End term- 50
- Mid Term- 50
- Practical- 25
- Elective

**Pre-requisites**

**Contact hours** 42 (Theory) 14 (Practical Sessions)

**THEORY**  Time  3 hours

**Objectives**
- To provide students about basic knowledge of A.C and D.C circuits, theorems, laws.
- Introduce to the students about difference between single phase and three phase system.
- To teach the students basic principle of operation of transformers and other electrical machines.
- To make them aware of the difference between analog and digital system and study diodes, rectifiers, digital circuits.

**Note for examiner**
The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.

**SECTION A**  Hrs

- DC Circuits and Single Phase A.C. Fundamentals  10
- General introduction to Electrical Engineering, Kirchoff’s Laws, Mesh and Node analysis,
Superposition theorem, Thevenin Theorem, Norton Theorem, Maximum power transfer theorem. Generation of alternating voltages and currents, Equations for AC quantities, cycle, time period, frequency, amplitude, calculation of R.M.S values, Average values for different waveforms, solution and phasor diagram of single phase AC circuit with sinusoidal source of excitation, series and parallel combination of R-L-C circuits.

Three Phase AC Fundamentals
Disadvantages of single phase system, star and delta connection in three phase circuits, relation between line and phasor quantities, power in three phase system, solution of three phase balanced circuits, power and power factor measurement by two wattmeter method.

Electrical Machines

SECTION B

Semiconductor Diodes and Transistors
General introduction to Electronics. Concept of stiff Voltage and Current Source. PN Junction, Depletion layer, Barrier Potential, Forward and Reverse Bias, Breakdown voltage, V-I characteristics, Half wave and Full wave rectifiers, Zener diode. Introduction to junction transistors, Transistor amplifying action, CB, CE, CC-configuration characteristics.

Digital Electronics
Binary and Hexadecimal number system, conversion of numbers from one system to other, OR, Relations: Commutative, Associative and Distributive Laws. Concept of flip-flops, RS,JK flip flops, shift register.

Text Books

Reference Books

Course Assessment Methods
Assessment will consist of the following components
1. Mid-Term
   a. One best of two minor tests (50% of Mid-term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance. (10% of Mid-term marks)
2. End-Term

Course Outcomes
1. The student will understand how various loads are connected in circuits and difference between single and three phase system.
2. The students will know the principles and working of different types of electrical machines used in industry.
3. The students will have the basic knowledge of digitalization and conversion of physical quantity to digital quantity.

Electrical and Electronics Engineering Practical

Objectives
Students will be able
- to design electric circuits.
- To use voltmeter, ammeter and wattmeter
- Perform open circuit test and short circuit test on a single phase transformer and draw equivalent circuit
- To identify diode characteristics and transistor characteristics and perform experiments related to rectifiers (half-wave and full-wave)
- To verify various logical gates and networking theorems through experiments.

Practical session wise break-up (min eight experiments to be done)
1. Overview of the equipments, instruments and procedure to be used, safety precautions and report writing.
2. To study resonance in R-L-C series and parallel circuit.
3. Measurement of power and power factor by three voltmeter method.
4. Measurement of power and power factor by three ammeter method.
5. To measure power and power factor using a single wattmeter in a single phase circuit.
6. Measurement of power and power factor of three phase balanced load by two wattmeter method.
7. To perform open circuit test and short circuit test on a single phase transformer and draw equivalent circuit.
8. To obtain magnetization characteristics of DC Machine
9. Study the forward and reverse biased diode characteristics.
10. Study the CB, CE, CC transistor characteristics.
11. To obtain the waveforms of half wave rectifier circuit on CRO.
12. To obtain the waveforms of full wave rectifier circuit on CRO.
13. Verification of basic and universal gates.
14. To verify the thevenin theorem, nortan theorem, Maximum power transfer theorem

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Students will</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>have hands on knowledge about the design, purpose and working of R-L-C and parallel circuits</td>
</tr>
<tr>
<td></td>
<td>become confident in taking accurate readings of voltmeter, ammeter and wattmeter</td>
</tr>
<tr>
<td></td>
<td>have in depth knowledge about transformers, transistors, diodes and rectifiers and will be able to understand their applications in industry.</td>
</tr>
<tr>
<td></td>
<td>have knowledge about networking theorems and their utility in industry.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title</th>
<th>ENGINEERING MECHANICS</th>
<th>Credits</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>ESC 104</td>
<td>Semester:</td>
<td>1st</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L T P</td>
<td>2 1 1</td>
</tr>
<tr>
<td>Max marks</td>
<td>End term-</td>
<td>Mid term-</td>
<td>Practical --</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>Contact hours</td>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THEORY</th>
<th>Time</th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objectives</td>
<td>1. To make the students understand the fundamentals of engineering mechanics i.e. force systems, centre of gravity, moment of inertia and types of structures. 2. To learn kinetics of particles and kinematics of rigid bodies, friction and vibration.</td>
<td></td>
</tr>
<tr>
<td>Note for examiner</td>
<td>The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECTION A</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force System</td>
<td>4</td>
</tr>
<tr>
<td>Structure:</td>
<td>3</td>
</tr>
<tr>
<td>Plane truss, perfect and imperfect truss, assumption in the truss analysis, analysis of perfect plane trusses by the method of joints and method of section</td>
<td></td>
</tr>
<tr>
<td>Friction:</td>
<td>3</td>
</tr>
<tr>
<td>Static and kinetic friction, laws of dry friction, co-efficient of friction, angle of friction, angle of repose, cone of friction, friction of journal-bearing, friction in screws, derivation of equation ( \frac{T_1}{T_2} = \mu_c A ) and its application.</td>
<td></td>
</tr>
<tr>
<td>Centroid and Moment of Inertia:</td>
<td>3</td>
</tr>
<tr>
<td>Centre of gravity, centre of mass, centroid of line, area and volume, mass moment of inertia and area moment of inertia, polar moment of inertia, radius of gyration, parallel axis theorem.</td>
<td></td>
</tr>
</tbody>
</table>
Perpendicular Axis Theorem, Pappus theorems.

## SECTION B

### Kinetics of Particles:
Introduction to dynamics, rectilinear motion, plane curvilinear motion-rectangular co-ordinates, normal and tangential coordinates. Equation of motion, work energy equation, impulse and momentum, conservation of momentum, impact of bodies, co-efficient of restitution, loss of energy during impact.

### Kinematics of Rigid Bodies:
Concept of rigid body, types of rigid body motion, Plane, absolute and rectilinear motion, equation of motion in straight line, Equation of motion due to gravity, rigid body angular motion, relative velocity, relative acceleration (Corioli’s component excluded).

### Kinetics of Rigid Bodies:
Equation of motion, translatory motion, D’Alembert’s principle, circular motion about fixed axis, work energy relation for rotation, concept of virtual work.

### Vibration:
Classification of vibrations, degree of freedom, free vibrations, forced vibrations, Effect of damping, simple pendulum, torsion pendulum. Spring mass system-its damped (linear dash pot) and undamped free vibrations, Energy method.

### Recommended Books

### Course Assessment

#### Methods
Assessment will consist of the following components
1. Mid-Term
   a. One best of two minor tests (50% of Mid-term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance. (10% of Mid-term marks)
2. End-Term

### Course Outcomes
Students will be able to
- Describe force system, construct force body diagrams and calculate the reactions necessary to ensure static equilibrium.
- Describe trusses and define friction, its types and laws of friction.
- Determine centre of gravity and moment of inertia.
- Describe and examine kinematics of rigid bodies, equations of motion and vibrations.

### WORKSHOP PRACTICES

<table>
<thead>
<tr>
<th>Title</th>
<th>WORKSHOP PRACTICES</th>
<th>Credits</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>ESC 105</td>
<td>L T P</td>
<td>-3</td>
</tr>
<tr>
<td>Max marks</td>
<td>End term -- Mid term - Practical-25</td>
<td></td>
<td>N</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>Contact hours</td>
<td></td>
<td>28 (Practical Sessions)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| PRACTICAL

- To make the students understand the need and importance of different manufacturing techniques.
- To introduce the different tools and equipments used in mechanical workshops and develop the skill to use the same.

### Practical session wise breakup

**Carpentry Shop:** Description and use of carpenter's tools, Wood and timber, defects found in wood, seasoning of wood. Different types of timber in common use, making of lap joint, Bridle joint, dovetail joint and Mitre joint.

**Electric Tools:** Exercise of wiring in link clip and casting and causing wiring of lights with
switches in parallels, series and with 2 ways switches, Connecting energy meter, main switch and distribution board, testing a wiring installation for insulation resistance, Relevant Indian Electricity Rules.

**Machine Shop**: Classification of fabrication processes, machine tools and materials, introduction to working of lathe, shapper, milling and drilling machines, power hacksaw, shearing machine and grinding wheel. Simple turning, threading, drilling board and knurling operations on a lathe.

**Welding**: Introduction to electric arc welding, gas welding and their use in making different types of joints e.g. lap joint, butt joint and T joint.

**Recommended Books**

**Course Outcomes**
Students will be able to
- understand the theory of different manufacturing techniques and tools.
- do practices by hand.
### 2nd SEMESTER

<table>
<thead>
<tr>
<th>Title</th>
<th>ENGINEERING DRAWING</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>ESC 101</td>
<td>03</td>
</tr>
<tr>
<td>Semester:</td>
<td>2nd</td>
<td></td>
</tr>
<tr>
<td>L T P</td>
<td>- - 6</td>
<td></td>
</tr>
<tr>
<td>Max.Marks</td>
<td>End term - 25</td>
<td></td>
</tr>
<tr>
<td>Mid term -</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Practical - 75</td>
<td>Elective</td>
<td></td>
</tr>
<tr>
<td>Pre requisites</td>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>Contact Hours</td>
<td>28 (Practical</td>
<td></td>
</tr>
<tr>
<td>Hours</td>
<td>Sessions)</td>
<td></td>
</tr>
</tbody>
</table>

#### PRACTICAL

**Objectives**
- Objectives of the Engineering Drawing course is
  1. To introduce the students to visual science in the form of technical graphics.
  2. To give general instructions related to Theory of Orthographic Projection of points, lines, planes and solids as per the BIS codes prevalent to drawing practices.
  3. To upgrade the basic understanding and visualization of geometric objects and machine parts by introducing the students to section of solids, intersection and development of surfaces, isometric projection and orthographic projection of simple solids/blocks.
  4. To introduce the students to Computer graphics to enhance understanding of the subject.

**Practical session wise breakup**

<table>
<thead>
<tr>
<th>No. of Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction to engineering drawing, instruments, symbols and conventions in drawing practice.</td>
</tr>
<tr>
<td>2. Types of lines and BIS codes for lines, dimensioning</td>
</tr>
<tr>
<td>3. Introduction to methods of projections: Orthographic projection, Isometric projection</td>
</tr>
<tr>
<td>4. Projection of points, lines, planes and solids on principal and auxiliary planes.</td>
</tr>
<tr>
<td>5. Sectioning of solids, Intersection of solids</td>
</tr>
<tr>
<td>6. Development of surfaces</td>
</tr>
<tr>
<td>7. Drawing of threaded fasteners and assembly drawing</td>
</tr>
<tr>
<td>8. Introduction to CAD software.</td>
</tr>
</tbody>
</table>

**Recommended Books:**
1. P.S. Gill: Engineering Drawing
4. Sham Tickoo : Understanding AutoCAD 2006, Wiley Publication
5. James D. Bethune : AutoCAD, Pearson Publishers

**Course Assessment Methods**

The students will be assessed based upon the practical assignments and viva voce.

**Course Outcomes**

Student will be able to
1. understand the basics of engineering drawing.
2. visualize the different types of geometrical objects and the assembly drawing of machine parts.

<table>
<thead>
<tr>
<th>Title</th>
<th>COMPUTER PROGRAMMING</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>ESC102</td>
<td>03</td>
</tr>
<tr>
<td>Semester:</td>
<td>2nd</td>
<td></td>
</tr>
<tr>
<td>L T P</td>
<td>2 - 3</td>
<td></td>
</tr>
<tr>
<td>Max.Marks</td>
<td>End term- 25</td>
<td></td>
</tr>
<tr>
<td>Mid term- 25</td>
<td>Practical- 25</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Pre requisites</td>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>Contact Hours</td>
<td>28 (Theory)</td>
<td></td>
</tr>
<tr>
<td>Hours</td>
<td>14 (Practical</td>
<td></td>
</tr>
<tr>
<td>Sessions)</td>
<td>3 Hours</td>
<td></td>
</tr>
</tbody>
</table>

#### THEORY

**Objectives**

1. To develop logical skills so that students should be able to solve basic computing
problems.
2. To learn the syntax and usage of C++ programming constructs.

Note for the Examiner
The semester question paper of the subject will be of 25 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.

SECTION- A

<table>
<thead>
<tr>
<th>Topic</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction To Programming:</strong></td>
<td></td>
</tr>
<tr>
<td>Basic introduction to computers, block diagram of computer. Evolution of languages: Machine languages, Assembly languages, High-level languages. Software requirements for programming: System softwares like operating system, compiler, linker, loader. Application programs like editor. Overview of Algorithm and Flowcharts.</td>
<td>03</td>
</tr>
<tr>
<td><strong>Programming In C++:</strong></td>
<td></td>
</tr>
<tr>
<td>Data types in C++, Formatted input-output for printing integer, floating point numbers, characters and strings.</td>
<td>01</td>
</tr>
<tr>
<td><strong>Operators And Expression:</strong></td>
<td></td>
</tr>
<tr>
<td>Expressions in C++ and their evaluation. Precedence and associativity rules. Operators: arithmetic operators, relational operators, logical operators, miscellaneous operators.</td>
<td>02</td>
</tr>
<tr>
<td><strong>Statements:</strong></td>
<td></td>
</tr>
<tr>
<td>Decision making structures: if, if-else, nested if and if-else, switch-Case. Loop control structures: for, while, do-while. Role of statements like break, continue, go to.</td>
<td>06</td>
</tr>
</tbody>
</table>

SECTION- B

<table>
<thead>
<tr>
<th>Topic</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arrays:</strong></td>
<td></td>
</tr>
<tr>
<td>Concept and use of arrays, declaration and usage of 1-dimensional arrays and 2-dimensional arrays.</td>
<td>04</td>
</tr>
<tr>
<td><strong>Functions:</strong></td>
<td></td>
</tr>
<tr>
<td>Advantage of modularizing C++ program into functions, function definition and function invocation. Methods of passing parameters to a function: call-by-value, call-by-reference; Passing arrays to functions, Recursion, Library functions.</td>
<td>04</td>
</tr>
<tr>
<td><strong>Introduction To User-Defined Data Types:</strong></td>
<td></td>
</tr>
<tr>
<td>Structures: declaration, use. Unions: definition, declaration, use, introduction to classes and Properties of object oriented programming.</td>
<td>04</td>
</tr>
<tr>
<td><strong>Introduction to Numerical Methods And Spreadsheet Calculations:</strong></td>
<td></td>
</tr>
<tr>
<td>Developing programs to solve engineering computation problems and working with spreadsheets.</td>
<td>04</td>
</tr>
</tbody>
</table>

Text books:

Reference Books:
2. Lafore, Robert “Object Orients Programming in C++”

Assessment will consist of the following components
1. Mid-Term
   a. One best of two minor tests (50% of Mid-term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance. (10% of Mid-term marks)
2. End-Term

Course Outcomes
1. The student will demonstrate proficiency in C++ programming language.
2. The student will be able to solve basic engineering computation problems using C++

COMPUTER PROGRAMMING (PRACTICAL)

Objectives
1. To develop programs using C++
2. To make the students design programs by using logic and become confident in handling numerical problems.

Practical Session Wise Break Up
1. Programs based on input & output in C++

No. of Sessions
02
2. Programs using Decision Statements if-else, CASE 02
3. Programs using while statements, do- while and for Loops 03
4. Array based programs 02
5. Developing user defined Functions with and without recursion 02
6. How to create and access user defined data types 01
7. Implementation of engineering computation programs and using spreadsheet calculations. 02

**Course Assessment Methods**

<table>
<thead>
<tr>
<th>Course Assessment Methods</th>
<th>The students will be assessed based upon the practical assignments and viva voce</th>
</tr>
</thead>
</table>

**Course Outcomes**

1. The students will be able to demonstrate proficiency in C++
2. The student will become confident in solving any computation problem using his programming skills.

<table>
<thead>
<tr>
<th>Title</th>
<th>INORGANIC CHEMISTRY</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>BSC 102</td>
<td>04</td>
</tr>
<tr>
<td>Max. Marks</td>
<td>End term- 40 Mid term- 35 Practical- 25 Elective</td>
<td>40 35 25 N</td>
</tr>
<tr>
<td>Pre requisites</td>
<td></td>
<td>42 (Theory) 14 (Practical Sessions)</td>
</tr>
</tbody>
</table>

**THEORY**

<table>
<thead>
<tr>
<th>Objectives</th>
<th>1. To introduce to the students the basics of quantum mechanics to derive the Schroedinger wave equation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. To introduce the basic theories of bonding in simple ionic and covalent compounds as well as coordinate complexes and organometallic compounds and application of organometallics as catalysts</td>
</tr>
<tr>
<td></td>
<td>3. To make the students understand the crystal field theory and the splitting of d-orbitals for different geometries</td>
</tr>
<tr>
<td></td>
<td>4. To create an awareness regarding the toxic effects of heavy metals and also the role of metals like cobalt and iron in biological systems</td>
</tr>
<tr>
<td></td>
<td>5. To introduce the importance of inorganic polymers</td>
</tr>
</tbody>
</table>

**Note for the Examiner**

The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.

**SECTION- A**

<table>
<thead>
<tr>
<th>Quantum theory and atomic structure:</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to wave mechanics, the Schroedinger equation, as applied to hydrogen atom, the origin of quantum numbers and shapes of orbitals from the Schroedinger equation.</td>
<td>05</td>
</tr>
</tbody>
</table>

**Chemical Bonding:**

Molecular orbital and valence bond theories of bond formation and application of molecular orbital theory to the formation of homonuclear and heteronuclear diatomic molecules.

<table>
<thead>
<tr>
<th>Coordination Compounds: Part 1:</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Werner’s theory, effective atomic number, bonding of transition metal complexes: valence bond theory, crystal field theory, crystal field splitting in tetrahedral, octahedral and distorted octahedral (square planar) crystal fields. Thermodynamic aspects of coordination compounds (crystal field stabilization energies of octahedral and tetrahedral complexes, spectrochemical series).</td>
<td>08</td>
</tr>
</tbody>
</table>

**SECTION- B**

<table>
<thead>
<tr>
<th>Coordination Compounds: Part 2:</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinetic aspects of coordination compounds (substitution reactions in complexes with coordination number 4 and 6 and their mechanism - SN(^4), SN(^2)). Magnetic behaviour of complexes – Para magnetism, diamagnetism, ferromagnetism and antiferromagnetism and measurement of magnetic susceptibility of complexes by Guoy’s method.</td>
<td>06</td>
</tr>
</tbody>
</table>

**Organometallic Compounds:**

Nomenclature, types of ligands and bonding in organometallic compounds, use of | 05 |
<table>
<thead>
<tr>
<th>Inorganic polymers:</th>
<th>Types of inorganic polymers, polyphosphazenes, polysiloxanes –their structures and properties.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role of Metals in Biological Systems:</td>
<td>Bio-inorganic Chemistry of Iron – Heme proteins &amp; Non-Heme iron proteins;</td>
</tr>
<tr>
<td>Metal Toxicology:</td>
<td>Toxic effects of heavy metals with special reference to Cd, Pb, Hg and As.</td>
</tr>
</tbody>
</table>

**Recommended Books:**


**Course Assessment Methods**

Assessment will consist of the following components

1. Mid-Term
   a. One best of two minor tests (50% of Mid-term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance (10% of Mid-term marks)

2. End – Term

**Course Outcomes**

Upon successful completion of this course, students will be able to:

1. Understand the basic concepts of quantum mechanics and derive the Schroedinger equation for the hydrogen atom and the origin of quantum numbers and shapes of orbitals from the Schroedinger equation.
2. Describe the fundamental principles of theories of bonding and molecular structure and construct M.O diagrams for simple homonuclear and heteronuclear diatomics.
3. Understand the Structure of ionic solids and the concepts of lattice energy and solvation and their importance as well as crystal defects and applications of defect structures.
4. Explain the bonding in organometallic and Coordination Compounds, the concept of splitting of d-orbitals in a crystal field with the explanation of magnetic and spectral properties as well as the Kinetic and thermodynamic aspects of ligand substitution reactions in coordination compounds.
5. Recognise the importance of Metals in Biological System and Toxicity of heavy metals.
6. Understand the importance of inorganic polymers.

**INORGANIC CHEMISTRY (PRACTICAL)**

**Objectives**

1. To introduce the different concepts for expressing concentration e.g molarity, molality and normality.
2. To explain the volumetric and gravimetric methods for quantitative analyses and the importance of these methods.
3. To explain the application of redox titrations.
4. To introduce complexometric titrations.

**Practical session wise break-up**

<table>
<thead>
<tr>
<th>No. of sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Volumetric Analysis :</td>
</tr>
<tr>
<td>(i) Redox Titrations :-Titrations involving</td>
</tr>
</tbody>
</table>
a) KMnO₄ (Estimation of C₂O₄²⁻)  02
b) K₂Cr₂O₇ (Estimation of Fe³⁺/Fe²⁺)  02
c) Iodine [Iodometry & Iodimetry] (Standardisation with Sodium Thiosulphate, Estimation of Cu²⁺, AsO₃³⁻ and Sb³⁺)  04

ii) Complexometric Titrations - Determination of Zn²⁺ by EDTA titration.  02

II) Gravimetric Analysis
a) Estimation of Ba²⁺/SO₄²⁻ as BaSO₄  04
b) Estimation of Fe³⁺/Fe²⁺ as Fe₂O₃  04

Text Book: Vogel's Qualitative Inorganic Analysis, 7th Ed. By G. Svehla, Pearson Education.

Course Assessment Methods
The expected outcomes would be assessed through performance reports, quizzes/viva voce and end semester evaluation test.

Course Outcomes
The student will be capable to
- apply the concept of normality and perform and apply redox titrations involving potassium dichromate and iodine
- Use Complexometric Titrations to determine Zn and Calcium ions by EDTA method.
- Estimate Ba²⁺/SO₄²⁻ as BaSO₄ and Fe³⁺ as Fe₂O₃ gravimetrically.

<table>
<thead>
<tr>
<th>Title</th>
<th>MATHEMATICS-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>BSC 103</td>
</tr>
<tr>
<td>Credits</td>
<td>4</td>
</tr>
<tr>
<td>Semester 2nd</td>
<td></td>
</tr>
<tr>
<td>L T P</td>
<td>3 1 -</td>
</tr>
<tr>
<td>Max marks</td>
<td>End term- 50 Mid term- 50 Practical --</td>
</tr>
<tr>
<td>Practical</td>
<td>Elective N</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>Mathematics-I (101)</td>
</tr>
<tr>
<td>Contact hours</td>
<td>42</td>
</tr>
</tbody>
</table>

Theory Time 3 hours

Objectives
To students shall
- Learn to expand various functions in terms of Fourier series.
- Learn the methods to formulate and solve partial differential equations.
- Be taught to apply the method of separation of variables to solve partial differential equations of engineering interest.
- Learn to find Laplace transforms and inverse transforms and apply these to solve differential equations.
- Understand the concept of Complex functions and their applications to various problems.

Note for examiner
The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.

SECTION A

<table>
<thead>
<tr>
<th>Fourier Series</th>
<th>Euler’s Formulae, Dirchiet’s Conditions for Expansion, Change of interval, Odd and Even Functions, Expansion of Odd and Even Periodic Functions, Introduction to Harmonic Analysis.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial Differential Equations (Pde’s)</td>
<td>Formation and classification of partial differential equations, first order linear equations, standard forms of non linear equations, Charpit’s method, homogeneous linear equations with constant coefficients.</td>
</tr>
<tr>
<td>Engineering Applications Of Pde’s</td>
<td>Method of separation of variables, Solution of partial differential equations of engineering interest by the method of separation of variables.</td>
</tr>
</tbody>
</table>

SECTION B

<table>
<thead>
<tr>
<th>Laplace Transforms</th>
<th>Definition, Transforms of Elementary functions, Properties of Transforms, Inverse Transforms, Transforms of Derivatives, Unit Step Function, Dirac’s Delta Function &amp; Unit Impulse function. Periodic Functions, Application of Transform to the solution of ordinary Differential equations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective N</td>
<td>12</td>
</tr>
</tbody>
</table>
Calculus Of Complex Functions
Functions of complex variables, analytic functions, Cauchy-Riemann equations, Cauchy’s theorem, Cauchy’s integral formula, introduction to Taylor’s series and Laurent’s series, Residues, Residue theorem and its simple applications.

Text Books

Reference Books
3. Differential Equations, Frank Ayers, TMH

Course Assessment Methods
Assessment will consist of the following components
1. Mid-Term
   a. One best of two minor tests (50% of Mid-term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance. (10% of Mid-term marks)
2. End-Term

Course Outcomes
The students are able to:
- expand functions in terms of Fourier series.
- formulate and solve partial differential equations.
- solve partial differential equations of engineering interest.
- find Laplace transforms, inverse transforms and apply these to solve various differential equations.
- evaluate complex integrals and apply these to various problems.

Title
INTRODUCTION TO ENGINEERING & TECHNOLOGY
Credits 03

Code
CHE-101 Semester:- 2nd

Max. Marks
End term- 40 Mid term- 35 Practical -- Elective N

Pre requisites
Contact Hours 42

THEORY
Time 3 Hours

Objectives
1. To provide a comprehensive overview of the engineering profession and practice.
2. To develop systematic problem solving skills and enhance confidence in the students through varied numerical problems.
3. To prepare the students to formulate and solve material balances on chemical process systems.

Note for the Examiner
The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.

SECTION- A

Definition of Engineering:

1. Systematic analysis of chemical processes:
Unit operations and unit processes, material and energy balances, thermodynamics, chemical reaction engineering, process instrumentation, process control and economics.

2. Introduction to Engineering Calculations:
Units and dimensions, conversion of units, systems of units, conventions in methods of analysis and measurement, numerical calculation and estimation, dimensional
homogeneity and dimensionless quantities, process data representation and analysis, Conversions involving process variables like pressure, temperature, density/specific gravity, mass, volume, flow rate and chemical composition. Chemical equation and stoichiometry.

SECTION - B

P-V-T relations for gas and gas mixtures, calculations using ideal gas law, Use of compressibility charts and equations of state (Van der Waals’) to predict real gas properties from experimental data. 06

Liquid and liquid mixtures: Vapour pressures (cox chart, Duhrings lines, Clausius Clapeyron equation), saturation, vapour-liquid equilibrium calculations using Raoult’s law and Henry’s law, partial saturation and humidity, material balances involving condensation and vaporization. 10

Introduction to material balances without chemical reactions, material balance on multiple–unit processes, Recycle, Bypass and Purge calculations. 10

Text books:

Reference Books:

Course Assessment Methods
Assessment will consist of the following components
1. Mid-Term
   a. One best of two minor tests (50% of Mid-term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance. (10% of Mid-term marks)
2. End-Term

Course Outcomes
1. The student will recognise his/her role as an engineer in the society and the associated responsibility lying ahead. The budding engineers will have a better understanding of professional ethics and importance of team work in achieving the professional goals.
2. The course will enable the students to analyze the local and global impact of engineering solutions and applications on individuals, organizations and hence its impact on society.
3. It will enable the students to identify, formulate and solve chemical engineering problems using law of conservation of mass and engineering sciences.
4. Students will be capable of representing and analysing the experimental process data that would be helpful in solving engineering problems.

<table>
<thead>
<tr>
<th>Title</th>
<th>ETHICS AND SELF-AWARENESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>HSSC 101</td>
</tr>
<tr>
<td>Max.Marks</td>
<td>End term- 25</td>
</tr>
<tr>
<td>Pre requisites</td>
<td></td>
</tr>
<tr>
<td>Contacts Hours</td>
<td></td>
</tr>
<tr>
<td>THEORY Time</td>
<td>3 Hours</td>
</tr>
</tbody>
</table>
| Objectives | 1. To provide basic knowledge about ethics, values, norms and standards and their importance in life.
2. To improve the personality of students by their self-assessment.
3. To imbibe positive thinking in students, thereby enhancing the quality of life of students and henceforth the nation as a whole.

Note for the Examiner
The semester question paper of the subject will be of 25 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting
<table>
<thead>
<tr>
<th>SECTION- A</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction to Ethics:</strong></td>
<td>06</td>
</tr>
<tr>
<td>Concept of Ethics – Nature, Scope, Sources, Types, Functions and Factors influencing Ethics, Approaches to Ethics – Psychological, Philosophical and Social, Broader Ethical Issues in Society.</td>
<td></td>
</tr>
<tr>
<td><strong>Values, Norms, Standards and Morality:</strong></td>
<td>04</td>
</tr>
<tr>
<td>Concept and Role, Relation with Ethics, Psycho-Social Theories of Moral Development – Kohlberg and Carol Gilligan.</td>
<td></td>
</tr>
<tr>
<td><strong>Ethics and Business:</strong></td>
<td>05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECTION- B</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-Awareness:</strong></td>
<td>04</td>
</tr>
<tr>
<td><strong>Self-Development:</strong></td>
<td>09</td>
</tr>
<tr>
<td>Concept of Self-Development, Social Intelligence, Emotional Intelligence, Managing Time and Stress, Positive Human Qualities (Self-Efficacy, Empathy, Gratitude, Compassion, Forgiveness and Motivation), Personality Development Models – Johari Window, Transactional Analysis, Myers Briggs Type Indicator, Self-Awareness and Self-Development Exercises.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommended books:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Hall, Calvin S., Lindzey, Dardner and Cambell, John B., “Theories of Personality”, Hamilton Printing Company</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Assessment Methods</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment will consist of the following components</td>
<td></td>
</tr>
<tr>
<td>1. Mid-Term</td>
<td></td>
</tr>
<tr>
<td>a. One best of two minor tests (50% of Mid-term marks)</td>
<td></td>
</tr>
<tr>
<td>b. Assignments (20% of Mid-term marks)</td>
<td></td>
</tr>
<tr>
<td>c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)</td>
<td></td>
</tr>
<tr>
<td>d. Attendance. (10% of Mid-term marks)</td>
<td></td>
</tr>
<tr>
<td>2. End –Term</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The students will become a better human being by being able to distinguish between right and wrong in both personal and professional front.</td>
<td></td>
</tr>
<tr>
<td>2. The students will be able to realize the importance of ethics, moral values, duties and self awareness.</td>
<td></td>
</tr>
<tr>
<td>3. The students will be able to identify their strengths, weaknesses, opportunities &amp; threats and work enthusiastically to transform weaknesses into strengths and threats into opportunities</td>
<td></td>
</tr>
</tbody>
</table>
**Semester - 3rd**

<table>
<thead>
<tr>
<th>Title</th>
<th>Credits</th>
<th>Code</th>
<th>Semester: 3rd</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROCESS PLANT MATERIAL AND ENERGY BALANCE</td>
<td>04</td>
<td>CHE 203</td>
<td>L T P</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max. Marks</th>
<th>Pre requisites</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>End term 50</td>
<td>-</td>
<td>42 (Theory)</td>
</tr>
<tr>
<td>Mid term 50</td>
<td></td>
<td>14 (Practical Sessions)</td>
</tr>
<tr>
<td>Practical --</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>

**THEORY**

Note for the Examiner: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION- A**

**Review:** Stoichiometric and composition relationship gas laws; Gaseous mixtures, vapor pressure, humidity, etc. Material Balances for Non-reaction systems including balances involving recycle and by-pass streams. Material Balances for Reacting systems including balances involving recycle and purge streams.

**SECTION- B**

Combustion Calculations.
Energy balances on nonreactive and reactive systems.

**Recommended Books**


---

**Semester - 4th**

<table>
<thead>
<tr>
<th>Title</th>
<th>Credits</th>
<th>Code</th>
<th>Semester: 4th</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLUID FLOW</td>
<td>04</td>
<td>CHE 202</td>
<td>L T P</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max. Marks</th>
<th>Pre requisites</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>End term 50</td>
<td>-</td>
<td>42 (Theory)</td>
</tr>
<tr>
<td>Mid term 50</td>
<td></td>
<td>14 (Practical Sessions)</td>
</tr>
<tr>
<td>Practical 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>

**THEORY**

Note for the Examiner: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION- A**

**Fluid Statics:** Normal forces in fluids, Pressure Measurements, Forces on Submerged bodies, Buoyancy and Stability.


**Flow of Incompressible Fluids:** Laminar and Turbulent flow in pipes, Velocity Distribution in Pipes, Frictional Losses in Pipes and Fittings, Fanning equation, Estimation of economic pipe diameter. Derivation of HAGEN-POISEULLI and f=16/Re equations.

**SECTION- B**

Dimensional analysis and its Applications to Fluid Flow.
**Flow of compressible fluids**: Compressible flow and flow through nozzles.

**Flow Measurements**: Pilot tube, Orifice, Venturi, Rotameter and Notches, wet gas metre etc.

**Fluid Machinery**: Classification and Performance of Pumps, Turbines, Compressors, and Blowers, Selection and Specification, Net positive Suction Head.

### PRACTICALS
1. General study of pipe fittings, valves and other equipments in the unit operations laboratory.
2. Pressure drop for flow through pipelines, valves & fittings.
3. Characteristics of pumps.
4. Flow measurement by the use of orifice meter, venturimeter, rotameter & pitot tube.
5. Flow over weirs and notches.
6. Flow measurement of compressible fluids.

### Recommended Books

<table>
<thead>
<tr>
<th>Title</th>
<th>ENGINEERING MATERIALS</th>
<th>Credits</th>
<th>04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>CHE 208</td>
<td>Semester: - 3rd</td>
<td>L T P 3 1 -</td>
</tr>
<tr>
<td>Max. Marks</td>
<td>End term 50</td>
<td>Mid term 50</td>
<td>Practical – 0</td>
</tr>
<tr>
<td>Pre requisites</td>
<td>-</td>
<td></td>
<td>Contact Hours 42 Hours</td>
</tr>
</tbody>
</table>

### THEORY

**Note for the Examiner**: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

#### SECTION- A

**Atomic Structure**: Review of bonding in solids, structure –property-processing Relationships

**Crystal Structure**: Space lattice, crystal systems, Miller indices, effect of radius ratio on co-ordination, structures of common metallic, polymeric, ceramic, amorphous and partly crystalline materials.

**Imperfections in atomic arrangement**: Various defects in atomic arrangement, diffusion phenomenon in solids, Fick’s first and second law of diffusion, solid solution, slip systems, various methods of strengthening materials, Schmid’s law.

#### SECTION- B

**Phase Diagrams and phase transformation**: Binary phase diagrams – Fe-Fe3C, Cu-Ni, Pb-Sn. microstructure development, TTT diagrams, heat treatment processes-hot and cold working, hardening and softening processes.

**Materials**: Standards and specifications, unified alloy numbering system, ferrous metals and alloys, nonferrous metals and alloys; overview of ceramic, polymeric and composite materials;

**Mechanical tests**: Standard test procedures for mechanical property determination-strength, toughness, fracture toughness, hardness, deformation, fatigue, creep etc.

**Corrosion**: Types and mechanism of corrosion, factors influencing corrosion, combating corrosion, selection of materials of construction for handling different chemicals.

### Recommended Books
4. Raghavan, V. : Material Science & Engineering, Prentice Hall of India
<table>
<thead>
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**THEORY**

Note for the Examiner

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION- A**

**Matrices:** Rank of a matrix, Elementary transformations, Eigen-values, Eigen-vectors, Cayley-Hamilton Theorem and its application to find inverse of a matrix.

**Difference equations:** Solution of difference equations with constant coefficients, Complementary function and Particular solution.

**Z-Transforms:** Introduction, Some standard Z-transforms, Linearity property, Damping rule, Some standard results, Shifting rules, Initial and Final value theorems, Convolution theorem, Evaluation of inverse transforms, Applications in the solution of difference equations.

**SECTION- B**

**Series solution of differential equations:** Solution of differential equations in series with reference to Bessel and Legendre equations, elementary properties of Bessel and Legendre functions.

**Statistics:** Binomial distribution, Poisson distribution and Normal distribution, Test of significance for large samples, Comparison of large samples, Means of two large samples, Student’s t-distribution, chi²-test, Goodness of fit.

**Recommended Books**


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**THEORY**

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**SECTION- A**

**Classification of organic compounds:** IUPAC nomenclature, Structural isomerism, Cis-trans isomerism. Shapes and Molecular orbital structures of compounds containing C, N and O. Conformations of alkanes. Organic reagents and reaction intermediates: structures of dienes, pyridine, pyrrole, aromatic compounds. Optical isomerism, Chirality and optical activity; Enantiomers, Diastereomers, Meso-and Racemic compounds. Resolution of racemic mixture. Asymmetric synthesis, Walden Inversion, Configuration (D and L nomenclature), Absolute con figuration (R and S nomenclature).

**Chemistry of hydrocarbons:** House synthesis, halogenation of alkanes, free radical mechanism, orientation, reactivity and selectivity. Cracking effect of structure on physical properties of compounds. Alkenes, catalytic hydrogenation, dehydration of alcohols, dehydrohalogenation, Saytzeff rule, electrophilic addition reactions,
peroxide effect, mechanism of allylic substitution, acidity of 1-alkynes, conjugated dienes, 1,2- and 1,4-additions, free radical and ionic mechanisms of addition polymerisation reactions, ring-opening reactions of cyclopropane and cyclobutane, chemistry of benzene and alkylbenzenes, aromatic electrophillic substitution reactions, Friedel-Crafts reactions

SECTION- B

Delocalisation: Concept of aromaticity, stability of cycloalkanes, resonance concept, inductive and mesomeric effects, directive effects, activating and deactivating groups. Hydrogen-bonding.

Chemistry of functional groups: Alkyl and aryl halides, nucleophilic substitution, synthetic utility of Grignard reagents and alkyllithiums, mechanism of Grignard reactions of alcohols, benzylalcohol, acidity of phenols epoxy compounds, Anisole nucleophilic addition, benzaldehyde, acetophene, benzophenone, aldol condensation, acidity of acids, alkyl and aryl amines.

Synthetic utility of diazonium salts, basicity of amines, multistep synthesis.

PRACTICAL

1. Lab – Safety
2. Preparation of Benzamide & Aspirin-Purification, determination of melting point and percentage yield.

Recommended Books

5. Mukherji & Singh: Reaction mechanism in organic chemistry, Macmillan India Ltd.,

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Max. Marks

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Contact Hours 42 Hours

THEORY

Note for the Examiner: The question paper should be divided into Section A and Section B. Total of 8 questions, 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION- A

Introduction: Statistics – Definition, Types. Types of variables – Organising data - Descriptive measures. Basic definitions and rules for probability, conditional probability independence of events, Baye’s theorem, and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions

Research Design: Meaning, Characteristics and various concepts relating to research design and classification of research design, Importance.

Data Collection: Sources of Data-Primary/Secondary Methods of collecting data; direct personal interview, indirect oral interview, information through local agencies, mailed questionnaire method, schedule sent through enumerators; questionnaire and its designing and characteristics of a good questionnaire.

Report Writing: Style/format, contents and essential steps for report writing

Sampling Distribution and Estimation: Introduction to sampling distributions, sampling distribution of mean and proportion, application of central limit theorem, sampling techniques. Estimation: Point and Interval estimates for population parameters of large sample and small samples, determining the sample size.

SECTION- B

Testing of hypothesis - parametric tests: Hypothesis testing: one sample and two sample tests for means and proportions of large samples (z-test), one sample and two sample tests for means of small samples (t-test), F-test
for two sample standard deviations. ANOVA one and two way.


**Correlation, regression and time series analysis**
Correlation analysis, estimation of regression line (Two/Three Variables) Time series analysis: Variations in time series, trend analysis, Least Square Method, cyclical variations, seasonal variations and irregular variations, forecasting errors.

**Recommended Books**
4. Ranjit Kumar: Research Methodology, Pearson Education 2009-02-20

**Practical:** Select an organization and study the planning, organizing, directing, staffing & controlling, etc., functions and prepare a short report or presentation and give public presentation in the class.

### Recommended Books

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Semester – 4

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**THEORY**

**Note for the Paper setter:** The question paper should be divided into Section A and Section B. Total of 8 questions. 4 questions from Section A and 4 questions from Section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION - A**

**Solutions:** Ideal and non-ideal solutions, Raoult’s law, change of free energy, enthalpy, and entropy on mixing of liquids, distillation of binary solutions. Partially miscible liquids such as Phenol-water, triethylamine-water, and Nicotine-water systems. Henry’s law, Nernst distribution law, Colligative properties of dilute solutions. Abnormal molar mass, degree of dissociation and association of solutes.

**Chemical Kinetics:** Rate equation of reactions of various orders, rate mechanism, kinetics of complex reactions. Concept of energy barrier and energy of activation. Theories of reaction rates, measurement of extent of reaction, zero order reactions. Rates of flow systems. Lindemann theory of unimolecular reactions.

**Surface Phenomena:** Adsorption of gases by solids. Types of adsorption, adsorption isotherms, Langmuir’s adsorption equation, B.E.T. equation for determination of surface area of adsorbents, applications of adsorption, catalysis, kinetics of surface reactions. Introduction to micelles, emulsions and gels.

**SECTION - B**

**Photochemistry:** Laws of photochemistry, principles of photochemical excitation, quantum efficiency, Kinetics of photochemical reactions.

**Electrochemistry:** Conductance of electrolytic solutions, transference number and its determination, Kohlrausch’s law of independent migration of ions, Interionic attraction theory, activity and activity coefficients of strong electrolytes, ionic equilibria. Ionization of water, ionization constants of weak acids and weak bases, hydrolysis, pH, commonion effect, solubility product and salt effect.

**Electrochemical Cells:** Reversible and irreversible cells, e.m.f. and its measurement, cell reactions and e.m.f., thermodynamics of electrode potentials, half-cell potential and its determination, Nernst equation, concentration cells, liquid junction potential, determination of activity co-efficient from cell potential data, potentiometric titrations.

**PRACTICAL**

1. Surface tension of liquids using Stalagmometer and calculation of Parachor values.
2. Distribution of iodine between water and carbon tetrachloride.
3. Kinetics of the hydrolysis of methyl acetate in the presence of hydrochloric acid.
4. Adsorption of acetic acid on activated charcoal.
5. Viscosity of liquids and composition of a binary solution.
6. Conductometry
   - Variation of equivalent conductance and specific conductance on dilution.
   - Dissociation constant of acetic acid.
   - Solubility of sparingly soluble salts.
   - Conductometric titrations of HCl vs NaOH and acetic acid vs NaOH.
7. Potentiometric titration of HCl vs NaOH and acetic acid vs NaOH and determination of dissociation constant of acetic acid.
8. Colorimetry
   - Verification of Lambert-Beer Law.
   - Determination of concentration of solution of KMnO₄/K₂Cr₂O₇.
   - Determination of composition of Fe-Salicylic Acid Complex by Job’s Method.

**Recommended Books**


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**THEORY**

**Note for the Examiner**

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION- A**


**SECTION- B**


Chemical Equilibria: Equilibrium constant in terms of measurable properties variations of equilibrium constant with temperature and pressure. Adiabatic reactions, Gibbs phase rule, equilibria in heterogeneous reactions.

**Recommended Books**


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The viva-voce examinations will be comprehensive and covering all subjects taught during first to fourth semesters.

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Note for the Paper setter: The question paper should be divided into Section A and Section B. Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION- A**

**Chlor-Alkali Industry:** Voltage efficiency, Current efficiency, Current density, Decomposition efficiency, Manufacture of soda ash by Solvay and Modified Solvay process, Manufacture of caustic soda.

**Sulphuric Acid:** Introduction, Manufacture of sulphuric acid by Chamber and Contact process, Material of construction, Storage and handling.

**Cement & Glass:** Cement - Types of cement, Constituents of cement, Manufacture of Portland cement. Glass - Introduction, Types of glass, Raw materials, Manufacture of glass.

**Ceramics:** Introduction, Properties of ceramics, Classification of refractories, Important steps involved in the manufacture of refractories.

**SECTION- B**

**Industrial gases:** Manufacture and uses of carbon dioxide, oxygen and nitrogen, acetylene.

Paints: Introduction, Classification of paints, Manufacture of paints, Requirement of a good Paint.

**Fertilizers:** Nitrogenous fertilizers- Manufacture of Ammonia, Nitric acid, Urea, CAN, Ammonium Sulphate. Phosphatic fertilizers- superphosphate and triple superphosphate.

**Potassic fertilizers-** Potassium Chloride and Potassium Sulphate, Safety aspects.

**PRACTICALS**

1. Fertilizers (i) Determination of N-P-K Values (ii) Determination of micronutrients
2. Cement: Loss of ignition, silica, insolubles, estimation of Mg, Ca, Fe.
3. Water.

**Recommended Books**

3. Dryden, C.E., Rao M.G. & Silting, M.
   : Outlines of Chemical Technology, 3rd Edition, Affiliated East
<table>
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**THEORY**

**Time**

3 Hours

**Note for the Examiner**

The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

### SECTION- A

**Stresses and Strains:** Concept of simple stress and simple strain, mechanical properties of solids, types of load, Tensile stress, compressive stress, shear stress, complementary shear stress, thermal stresses, tensile test, stress strain curve, Hooke’s law, modulus of elasticity, modulus of rigidity, Principle of St. Venant strain, factor of safety, compound bars, Compound Stresses and Compound Strains in two-dimensional stress system, Stresses on oblique plane due to pure shear, principle planes and principle stresses, maximum shear stress, Mohr’s circle of stress, Poisson’s ratio, volumetric strain, elastic constants and relations between them.

**Shearing Force and Bending Moments in Beams:** Shearing force, bending moment, types of beams, types of load on beams, types of supports, sign conventions for shearing force and bending moment, point of inflection, relations between bending moment and shearing force, shear force and bending moment diagrams for beam under different loads. Concentrated loads, uniformly distributed loads, numerical problems.

**Bending Stresses and Shearing Stresses in Beams:** Pure bending, graphical determination of moments of inertia, bending stress, composite beams, reinforced concrete beams, General eccentric loading, combined direct and bending stresses, eccentric longitudinal loads, Shear stress distribution in rectangular section and circular section, numerical problems.

**Deflection of Beam:** Introduction, Macaulay’s integration method, simply supported beam with load at mid span and beam with eccentric load, moment area method, deflection due to shear, numerical problems.

### SECTION-B

**Torsion of Shafts:** Torsion of thin circular shaft, composite shaft, combined bending and torsion, equivalent torque, equivalent bending moment, numerical problems.

**Struts and Columns:** Definition of strut and column, Euler’s Column theory and assumptions made, Strut with both ends pinned, strut with one end fixed and one end free, strut with both ends free, Slenderness ratio, limitations of Euler theory, Rankine’s Empirical formula, strut with eccentric loading, numerical problems.

**Stresses and Strains in Thin Shells:** Thin cylinder under internal pressure, thin spherical shell under internal pressure, volumetric strain, modifications for built-up shells, numerical problems.

**Stresses and Strains in Springs:** Types of Springs, stresses in Close coiled helical springs, open coiled helical springs, leaf springs, springs in parallel and in series, numerical problems.

**Strain Energy and Theories of Elastic Failure:** Strain energy and resilience, Strain energy in tension and compression due to suddenly applied load and impact loads, strain energy due to shear, strain energy due to bending, strain energy due to torsion, theories of elastic failure and their graphical representation, numerical problems.

### Books Recommended:

Title: PROCESS EQUIPMENT DESIGN

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Max. Marks

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<td>14 (Practical Sessions)</td>
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PRACTICAL LIST OF PRACTICALS

1. Study of factors influencing the design of vessels; classification of pressure vessels, applications, method of fabrications, fundamental principles and equations.
2. Study of pressure vessel codes specifications and standards; Review of code and its development, ASME codes, API-ASME code, Section VIII of ASME codes.
3. General design considerations for pressure vessels; Design pressure, design temperature, materials, design stress (nominal design strength), corrosion allowance, design loads, minimum practical wall thickness.
4. Design of thin-walled vessels under internal pressure; Cylinders and spherical shells, heads and closures, design of flat ends, design of domes ends, conical sections and end closures.
5. Design of vessels subject to external pressure; Cylindrical shells, design of stiffening rings, vessels heads.
6. Design of vessels subject to combined loading: Weight loads, wind loads (tall vessels), torque.
7. Design of welded joints and Bolted flanged joints.
8. Design of Foundation and supports.

Books Recommended:

1. Battacharyya, B.C.: Introduction to Chemical Equipment Design Mechanical aspects, Chemical Engineering Education Development Centre.
2. Brownell and Young: Process Equipment Design, Willey Publication
### Title: HEAT TRANSFER

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<td>The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.</td>
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**SECTION- A**

**Conduction:** Steady state conduction in one dimensional system, general conduction equation, effect of variable thermal conductivity, steady state conduction involving internal heat generation, lagging on pipes, the critical thickness of insulation on pipes, extended surfaces of uniform thickness and fin effectiveness, fin efficiency.

**Convection:** Free and forced convection, concept of heat transfer co-efficient, dimensionless numbers in free and forced convection, Dimensional analysis, Determination of Heat transfer coefficient using heat and momentum transfer analogies, experimental determination of heat transfer coefficient and common working correlations.

**Radiation Heat Transfer:** Black Body radiation, and grey body radiation, physical mechanism, radiation properties and shape factor, heat exchange between non-black bodies, radiation shields pyrometry and effect of radiation on temperature measurement.

**SECTION- B**

**Condensation and Boiling:** Condensation heat transfer phenomenon, film condensation on vertical plates and cylinders as well as on horizontal cylinders. Effects of non-condensable gases and vapor velocity on condensation, pool boiling, forced convection boiling, working correlations for pool boiling.

**Evaporation:** Types of Evaporators, single and multiple effects, single and multiple effects calculations, evaporator capacity, economy, effect of liquid head and boiling point elevation, methods of feeding.

**Heat Exchangers:** Various types of heat exchangers, overall heat transfer coefficients, heat exchanger mean temperature differences, heat exchanger effectiveness and the number of transfer units.

### Books Recommended:

1. Determination of heat transfer coefficient for different types of heat transfer equipment.
   Wilson plots.
2. Unsteady state heat transfer in jacketed vessels. (Open pan evaporator)
3. Correlation of instantaneous heat transfer coefficients with time study deposition of scale on a heating surface.
4. Determination of heat losses for insulated pipes
5. Study of double pipe heat exchanger and to determine overall heat transfer coefficient
6. Study the performance characteristics of a 1,2 - shell and tube heat exchanger
7. Study and operation of long tube, forced circulation and multiple effect evaporators.
8. Duhring plot for solutions involving nonvolatile solutes

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**THEORY**

Note for the Examiners: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION- A**

Mass transfer operations, classification of mass transfer operations, choice of separation methods, methods of conducting mass transfer operations, design principles.
Introduction to mass transfer and diffusion, molecular diffusion in gases and liquids, diffusion coefficients for gases and liquids, diffusion in solids, types of solid diffusion.
Mass transfer coefficients, types of mass transfer coefficients, mass transfer coefficients in laminar flow, theories of mass transfer.
Interphase mass transfer, concept of overall mass transfer coefficient.

**SECTION- B**

Working principle, construction and industrial applications of various gas liquid contacting equipments like sparged vessels, mechanically agitated vessels, tray towers, packed towers, spray chambers, venturi scrubbers.
Humidification operations, psychometric chart, adiabatic saturation temperatures, wet bulb temperature, adiabatic operations, types of cooling towers.
Principle of drying, batch drying, drying curve, constructional details and working of different dryers

**Recommended Books**

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<td>Contact Hours</td>
<td>14 (Practical Sessions)</td>
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**Practical**

2. Selection, specification & power requirements of process pumps, fans and blowers.
3. Design of settling equipments like Dor thickeners, dust chambers, cyclone separators and centrifuges.
4. Design of agitated vessels using various types of impellers.
5. Design of Conveyor system for solids.

**Recommended Books**


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**THEORY**

Note for the Examiner: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION- A**

*Oils & Fats:* Introduction, Extraction of oils from vegetable oils, refining of oils and fats, hydrogenation of oils.

*Soaps and Detergents:* Introduction, Raw materials, Manufacture of soap, Classification of detergents, finishing of detergents.

*Water:* Sources and Constraints, Consumption patterns; Impurities: dissolved, suspended, colloidal; Hardness of water; Water softening; Lime soda, ion exchange.

*Desalination:* Classification of processes; Evaporative processes, Multieffect evaporation, multistage flash, vapour compression; Membrane processes, Reverse osmosis, electrodialysis.

**SECTION- B**

*Pulp & paper:* Introduction, Raw Materials, types of pulp, Manufacture of paper.

*Sugar:* Introduction; Sugar extraction, defacation, sulphitation, carbonation, concentration, crystallization, drying, refining; Uses of molasses and bagasse.
Carbon Technology: Introduction, Classification of activated carbons, raw materials and manufacture of activated carbons, precursors for carbon fibres, manufacture of carbon fibres from polyacrylonitrile, manufacture of carbon black by furnace black process, applications.

Nanotechnology: Introduction and synthesis of nano particles by RF plasma process.

Practicals
1. Oils & Fats: Determination of Acid value, iodine value, Saponification value.
2. Carbohydrates: Reducing and non reducing sugars by (i) Fehling’s method (ii) Pavy’s method.
3. Soaps: Determination of free and combined alkali, total fatty matter, moisture and insoluble.

Recommended Books

OPERATIONS RESEARCH

<table>
<thead>
<tr>
<th>Title</th>
<th>OPERATIONS RESEARCH</th>
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<tbody>
<tr>
<td>Code</td>
<td>CHM 301</td>
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<td>5th</td>
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<td>End term 50 Mid term 50 Practical Elective</td>
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<td>Pre requisites</td>
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| THEORtY                | Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION- A
Linear Programming: problem formulation, graphical method, simplex method, duality sensitivity analysis.
Transportation model, Transhipment problem, traveling salesman problem, Assignment models, Sequencing model, Replacement model.

SECTION- B
Theory of Games: Pure strategy games, principle of dominance; mixed strategy games (Algebraic, Graphical & Linear programming method), 2-person, non-zero- sum games.
Queuing Theory: Introduction, elementary queuing system; single channel queuing model, queuing cost behaviour, multiple channel queuing model, Poisson arrivals and Erlang service distribution; benefits and limitations of queuing theory.

Recommended Books
SIXTH SEMESTER

<table>
<thead>
<tr>
<th>Title</th>
<th>NUMERICAL METHODS IN CHEMICAL ENGINEERING</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Code</td>
<td>CHE 301</td>
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<td>Contact Hours</td>
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</tr>
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</table>

**THEORY**

Note for the Examiner: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION- A**


**SECTION- B**


Numerical Solution of Partial Differential Equations: Finite-Difference Approximation to Laplace’s Equation, Parabolic Equations and Hyperbolic Equations

**Recommended Books**

ENERGY TECHNOLOGY

Credits: 4
Code: CHE 302
Semester: 6th
L T P: 3 1 1
Max. Marks: End term 50, Mid term 50, Practical: Elective
Pre requisites: -
Contact Hours: 42 (Theory)

THEORY

Note for the Examiner:
Note for the Paper setter: The question paper should be divided into Section A and Section B. Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION- A

Fuels: Types of conventional fuels, their merits and demerits. Non-conventional/renewable energy sources, their importance for sustainable development and environmental protection.


Liquid fuels: Origin of petroleum, refining and distillation of crude oil, uses of petroleum products.

Gaseous fuels: Natural gas, manufacture of water gas and producer gas, gas cleaning methods.

SECTION- B


Furnaces: Classification of furnaces, draught, furnace atmosphere, Portland cement continuous rotary kiln, blast furnace, glass melting furnace

Alternate sources of energy:
➤ Introduction to solar radiation and evaluation of radiation incident on a solar collector.
➤ Applications of solar thermal energy such as solar water heater, solar cooker, solar concentrators and solar thermal power generation.
➤ Types of solar photovoltaic systems and applications.
➤ Photosynthesis and biomass conversion systems.

Other renewable energy sources such as geothermal, tidal, ocean and wave.

Recommended Books


CHEMICAL REACTION ENGINEERING–I

Credits: 5
Code: CHE 303
Semester: 6th
L T P: 3 1 3
Max. Marks: End term 50, Mid term 50, Practical: Elective
Pre requisites: -
Contact Hours: 42 (Theory) 14 (Practical)
THEORY

Note for the Examiner

Note for the Paper setter: The question paper should be divided into Section A and Section B. Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION- A

Introduction and a brief review of the kinetics of homogeneous reactions.
Interpretation of rate data from constant volume and constant pressure systems.
Single Ideal reactors.
Design for single reactions.

SECTION- B

Design for multiple reactions.
Thermal characteristics of reactors: temperature and pressure effects.
Non-ideality in reactors and its effects on chemical conversion. One parameter models to represent the behaviour of chemical reactors.

Practical

1. Kinetic studies in a batch reactor.
2. Kinetic studies in a plug flow reactor.
3. Kinetic studies in a CSTR.
4. Kinetic studies in a semi batch reactor.
5. RTD studies in CSTR.
6. Dispersion number for packed bed reactor.
7. Adiabatic batch reactor.

Recommended Books


Title

CHEMICAL ENGINEERING COMPUTATION LAB. (Practical) Credits

Code

CHE 307 Semester: - 5th

Max. Marks

End term Mid term Practical: 25 Contact Hours

Pre requisites

- 14 (Practical Sessions)

Credits

1

L T P

- - 3

Practical

Errors analysis, Solution of linear and non-linear algebraic equations.
Numerical differential & integration.
Interpolation.
Least squares approximation.
Ordinary and partial differential equations.
Development of computer programs based on the above topics using Matlab and their applications in chemical process computations.
<table>
<thead>
<tr>
<th><strong>Recommended Books:</strong></th>
<th></th>
</tr>
</thead>
</table>
The image contains a page from a course syllabus, specifically from a course named "MASS TRANSFER-II (Theory)". The page provides details about the course, including the title, code, credits, prerequisites, and a breakdown of the theoretical and practical aspects of the course. The main content of the page is organized into sections, each detailing different topics covered in the course. The following is a transcription of the main text:

**Title**: MASS TRANSFER-II (Theory)

**Code**: CHE 309

**Credits**: 5

**Semester**: 6th

**L T P**: 3 1 3

**Max. Marks**: End term 50, Mid term 50, Practical: 25

**Elective**: N

**Pre requisites**: -

**Contact Hours**: 42 (Theory), 14 (Practical Sessions)

---

**THEORY**

**Note for the Examiner**: The question paper should be divided into Section A and Section B. Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION- A**


**SECTION- B**

Liquid-Liquid Extraction: Ternary Equilibria and its representation on various plots. Selection criteria for solvent, Multistage extraction using partially miscible & immiscible solvents. Stagewise contact for countercurrent and crosscurrent extraction. Constructional details of equipment like mixer-settler, packed columns, pulsed extractor, sieve-tray extractor and centrifugal extractor.

Leaching: Preparation of solid, countercurrent and crosscurrent multistage contact Shank’s system. Constructional details of equipment like Rotocel extractor, Hildebrandt extractor, Bollman extractor, Kennedy Extractor & Beet-Sugar Diffusion battery extractor.

Adsorption: Types of adsorption, nature of adsorbents, equilibria for adsorption systems. Brief manufacture and commercial applications and characteristics for common adsorbents. Stagewise & continuous contacting of fluid and solid phase. Description of contact filtration adsorption system. Hypersorber Ion-exchange system.


**Practical**

1. Determination of mass transfer coefficients for naphthalene-air system.
2. To determine drying rate curves for different wet solids in a batch drier under constant drying conditions.
3. Fractional approach to equilibrium for liquid-liquid extraction from single drop.
4. Verification of Rayleigh’s equation for differential distillation.
5. Determination of flooding velocities in packed columns.
6. Determination of HETP for packed distillation columns.
7. Study and operation of a pilot sized distillation column under total reflux.

Study of different mass transfer equipments

**Recommended Books**

<table>
<thead>
<tr>
<th>No.</th>
<th>Author(s)</th>
<th>Title</th>
</tr>
</thead>
</table>

**Title**

Process Plant Design-II

**Code**

CHE 405

**Credits**

1

**Max.Marks**

End term: 60
Mid term: 40
Practical: 25

**Contact Hours**

14 (Practical Sessions)

**Practical**

1. Process design and specifications of double pipe heat exchanger, shell and tube heat exchanger, plate type heat exchanger, condenser and reboiler.
2. Design of distillation column, calculation of number of plates, height and design of fractionator internals-sieve tray.
3. Absorber/Stripper design of stage-wise and continuous contact equipment (packed column), height of column and diameter calculations. HTU and NTU.
4. Design aspects of fixed bed reactors and fluidized bed reactors.

**Books Recommended:**

1. Coulson, Richardson & Sinnott, R.K.
2. Ludwig, E.E.
3. Perry, J.H.
4. Kern, D.Q.
5. Shell and Tube Type Heat Exchangers, Indian Standards.
6. Treybal, Robert E.
7. Levenspiel, O.
8. Walas, S.M.
   : Reaction Kinetics for Chemical Engg., McGraw Hill
9. Scott Fogler, H.
Managerial Economics

Credits 4

Code CHM302 Semester: 6th

Max.Marks End term 50 Mid term 50 Practical: Elective

Contact Hours 42 (Theory)

THEORY

Note for the Examiner: The question paper should be divided into Section A and Section B. Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION- A


Demand Concepts and Analysis: Individual Demand, Market Demand, Kinds of Demand, Determinants of Demand, Demand Functions, Functions, Demand Schedule and Law of Demand.

Theory of Consumer Behavior: Cardinal Utility Approach and Ordinal Utility (Indifference Curves) Approach;

Elasticity of Demand: Concept, Types, Measurement and importance.

Demand Forecasting: Sources of Data-Expert Opinions, Surveys and Market Experiments;

Time Series Analysis: Trend Projection; Barometric Forecasting-Leading Indicators, Composite and diffusion Indices.

SECTION- B

Production Function: Concept and types, Returns to Factor and Returns to Scale, Law of Variable Proportions.

Cost concepts and Analysis: Concept of Cost, Short run and Long-run Cost Curves, Relationships among various costs, Break-even Analysis.

Revenue Curves: Concept and Types.

Perfect Competition: Characteristics, Equilibrium Price, Profit Maximizing output in Short Run and Long Run;

Monopoly: Characteristics, Equilibrium Price, Profit Maximizing output in Short Run and Long Run; Price Discrimination;

Imperfect Competition: Monopolistic Competition, oligopoly and Barriers to Entry.

Recommended Books
8. Mote, Paul Gupta: Managerial Economics, Vikas Publisher, New Delhi, 1st ed.
# SEVENTH SEMESTER

<table>
<thead>
<tr>
<th>Title</th>
<th>CHEMICAL ENGINEERING-II</th>
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<td>Pre requisites</td>
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</tbody>
</table>

### THEORY

**Note for the Examiner**

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

### SECTION- A

Heterogeneous catalyses: A brief review of catalyses catalytic specificity. Preparation of catalysts, catalyst poisoning and catalyst regeneration.
Fluid Solid catalytic reaction: Kinetics; external transport processes, Reaction - and diffusion within porous spherical catalyst pellet. Effective diffusivity, thermal conductivity and effectiveness factors.

### SECTION- B

Fluid - fluid reactions rate equations and their application to the design of reactors.
Fluid Solid non-catalytic reactors rate equations and their application to the design of reactors.
Analysis of rate data design outline and selection of fixed bed, fluidised bed and slurry reactors for fluid solid catalytic reactions.

### Recommended Books

1. Levenspiel, O : Chemical Reaction Engg., John Wiley

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<table>
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<th>Title</th>
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</table>

### THEORY

**Note for the Examiner**

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

### SECTION- A

Incentives for chemical process control, design aspects of a process control system. Difference between feedback and feed forward control configuration. Hardware elements of a control system, Block Diagrams.
Laplace transform and transfer functions. Difference between lumped and distributed parameter systems, Dynamic behaviour of first and higher order systems, interacting and non-interacting systems, dead time.

Different modes of control actions and their basic characteristics, controllers and their characteristics, control valve.

**SECTION- B**

Closed-loop transfer functions, transient response of simple control systems, Routh stability criterion, Root Locus.

Introduction to frequency response: Bode diagrams, control system design by frequency response: Ziegler-Nichols controller settings, stability using frequency response, gain margin and phase margin.

Introduction to advanced control techniques such as cascade control, feed forward control, ratio control, inferential control.

**Practical**

1. **U-Tube manometer**
   (a) To plot the response curve for a given input to a U-tube manometer.
   (b) To determine the transfer function from the response curve obtained in part (a).

2. **Time constant of a mercury thermometer**
   To study the dynamics of the given thermometer and compare the theoretical value of its time constant with the experimental value.

3. **Analysis of valve**
   Develop a block diagram representing the dynamic behaviour of the given globe valve.

4. **(a) Liquid level measurement**
   With the given Bubbler System for Liquid Level Measurement, evaluate liquid height in the tank and compare it with actual values.
   (b) **Calibration of Pressure Gauge**
   Calibrate a pressure gauge in the range 0 psi to 60 psi.

5. **Temperature control system**
   To maintain the temperature of the fluid at the set point value.

6. **Time constant of liquid level tank**
   To study the dynamics of liquid level in a tank and compare the analytical value of the time constant with the experimental value.

7. **Liquid level control**
   (a) To carry out the closed loop experiment on the given liquid level control system and record its response for step change in the inlet flow.
   (b) To plot the experimental response curve and comment on the response obtained.

8. **Compurec**
   Pressure control simulation with step input and sinusoidal input.

**Recommended Books**

**TITLE**

**Process Engineering Economics**

**Credits** 4

**Code** CHE 408

**Semester:** 7th

**L T P** 3 1 -

**Max.Marks**

End term 50  
Mid term 50  
Practical  
Elective N

**Pre requisites**

-  

**Contact Hours** 42 (Theory)

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**THEORY**

**Note for the Examiner**

The question paper should be divided into Section A and Section B. Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION-A**


*Interest and Investment Costs:* Simple and compound interest. Nominal and effective rates of interest. Continuous interest ordinary annuity. Perpetuities and capitalized costs.

*Taxes and Insurance:* Types of taxes and tax returns, types of insurance and legal responsibility.

*Depreciation:* Types of depreciation. Service life salvage value, present value and methods of determining depreciation, single unit and group depreciation.

**SECTION-B**


*Optimum Design:* Procedure with one variable, optimum reflux ratio in distillation and other examples.

*Preliminary Steps in Plant Design:* Plant design factors. project organization, plant location, preliminary data collection, process engineering

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**Books Recommended:**

Title: Literature Survey, Report Writing & Seminar
Credits: S or X
Code: CHE 410
Semester: 7th
L T P: - - 3
Max.Marks: End term 50 Mid term 50 Practical: s or x Elective N
Pre requisites: - Contact Hours

Practical
Forms of technical reports: aims and forms according to type of readership and extent of circulation. Abstracts, extended abstracts, tables, graphs. Visual representation of data: slides, microfilms, others techniques including those of audio-visual representation. Correct use of audio equipment. Research papers and their presentation and publication. Information retrieve direct and through abstracts.
Practical training in writing and presentation of technical reports through audio-visual means. Technique of effective public speaking organized and imprompt discussions.
Preparation of technical report on an assigned topic after survey of scientific, technical and commercial literature, using card indexes, microfilms and other information retrieval methods.
Use of Computer softwares for report writing.

Books Recommended:
2. Sottle, R.T.: The Use of Chemical Literature, Butter Worths.

Title: Marketing Management
Credits: 4
Code: CHM 401
Semester: 7th
L T P: 3 1 -
Max.Marks: End term 50 Mid term 50 Practical Elective N
Pre requisites: - Contact Hours 42 (Theory)

THEORY
Note for the Examiner: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION-A
Introduction to Marketing: Definition; Scope and Importance of Marketing; Key Customer Markets; Concepts/Philosophies of Marketing; Holistic Marketing Concept; Marketing Tasks; Marketing Mix
Marketing Environment: Marketing Environment; New Marketing Realities; New Consumer Capabilities; Demographic Environment; Social-Cultural Environment; Natural Environment; Technological Environment and Political-Legal Environment; SWOT analysis.
Analyzing Markets: Marketing Research Process; Sources of data collection; factors influencing consumer behavior; buying decision process; post-purchase behavior; Organizational Buying; Stages in the Buying Process.
Market Segmentation: Levels of market segmentation; segmenting consumer markets; Niche Marketing; segmenting business markets; Michael Porter’s five forces model; Analyzing competitors; strategies for market leaders; Targeting and Positioning.

SECTION-B
Product Decisions: Product characteristics; classifications; differentiation; packaging and labeling; Product Life Cycle.
**Pricing Strategies:** Understanding Pricing; Setting the Price; Initiating and Responding to Price Changes; Reactions to Competitor’s Price Changes.

**Marketing Channels:** Marketing Channels; Role of Marketing Channels; Identifying Major Channel Alternatives; Types of Intermediaries; Channel-Management Decisions, Retailing, Wholesaling.

**Marketing Communication:** The Role of Marketing Communications; Communications Mix—Advertising, Sales Promotion, Public Relations and Publicity, Events and Experiences, Direct and Interactive Marketing, Personal Selling.

**Books Recommended:**

2. Ramaswamy, V.S. & Namakumari, S: Marketing management, planning, implementation and control, 3rd, Macmillan.
3. Hepner H.W.: Modern Marketing- Dynamics and Management, 11th, UBS.
6. Converse Paul and Harvey W. Hugg: Elements of Marketing, 7th ed., PHI.
## EIGHT SEMESTER

<table>
<thead>
<tr>
<th>Title</th>
<th>Transport Phenomena</th>
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### THEORY

**Note for the Examiner**

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### SECTION-A

Transport of momentum, heat and mass by molecular motion—Newton’s law of Viscosity, Fourier’s law of heat conduction, Fick’s law of diffusion.

Transport properties—Viscosity, thermal conductivity and mass diffusivity.

Emphasis on the analogy between momentum, heat and mass transfer with respect to transport mechanism and governing equations.

Development of mathematical models of transfer process through shell momentum balance, shell energy balance and shell mass balance for solving specific problems of transport of momentum, heat and mass in laminar flow or in solids in one dimension.

### SECTION-B

Development of general differential equations of fluid flow, heat transfer and mass transfer and their applications in solving one-dimensional steady state and unsteady state problems of momentum, heat and mass transfer.

Interphase transport of momentum, heat and mass and dimensionless correlation for each one of them.

Momentum, heat and mass transfer analysis.

**Books Recommended:**


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<table>
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<th>Title</th>
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<th>Credits</th>
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### THEORY

**Note for the Examiner**

Note for the Paper setter: The question paper should be divided into Section A and Section B. Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

### SECTION-A

Ambient air and water standards. Principal sources of pollution.

Inter-relationship between energy and environment pollution. Prevention of environmental
pollution through conservation, raw material substitutions, process and equipment modifications. A case study on the concept of zero discharge.

Air Pollution:
- Principal air pollutants and their usual sources.
- Effect of air pollutants on human health, animals, vegetation and materials.
- Atmospheric dispersion of air pollutants, temperature inversions, Estimation of pollutants by Gaussian plume model.
- Process and equipments used for the control of particulate pollutants.

SECTION-B

Water Pollution:
- Types of water pollutants, their sources and effects.
- BOD and COD
- Waste water treatment techniques and equipments, flocculation, skimming, floatation, etc.
- Primary Treatment-through settling.
- Secondary Treatment-Aerobic and anaerobic digestion, activated sludge process, trickle filter and oxidation ponds.

Solid wastes: Control and disposal, sanitary landfill, incineration, pyrolysis gasification and recycling.

Books Recommended:

Environment Engineering Laboratory (PRACTICALS)

1. To find BOD of water sample.
2. To find COD of waste sample.
3. To find the total dissolved solids (TDS) and its volatile and non-volatile components.
4. To find the total suspended solids (TSS) and its volatile and non-volatile components.
5. To do the chromium separation by different techniques from electroplating wastes.
6. To find the phenol content of water sample and evolution of parameters.
7. To operate the electrodialysis apparatus.
8. To find the biodegradation constant (K) and the effect of timing on it.
9. To use the membrane separation techniques for salt brine and reverse osmosis process for sugar.
10. To use stack monitoring kit to find:
    a. Efficiency of a cyclone.
    b. Dust sampling.

Note: Any six of the above mentioned experiments are to be conducted.
**Title**: Process Modelling & Simulation  
**Code**: CHE 403  
**Semester**: 8th  
**Credits**: 1  
**L T P**: 3

<table>
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<td>Pre requisite</td>
<td>Contact Hours</td>
<td>14 (Practical Sessions)</td>
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</tbody>
</table>

**Practical**

Functional design, property estimate as inputs for design. System concepts for computer aided design, computer aided flow sheet design. Process analysis. Process variables selection, equipment design through the selection of free parameters subject to constraints and other parameters, modular design. Simulation optimality. Dynamic design including control stability. 

Typical equipments to be considered: heat exchangers, distillations columns, reactor and process equipments.

**Books Recommended**:


**Paper Title**: PROJECT WORK

**Paper Code**: CHE 406

Each student is required to submit a project report on the design of a chemical plant, selecting the best process with optimum equipment size and operating conditions. The object is to test the ability of the student to apply his entire knowledge of Chemical Engineering principles to conceptualize, analyze and solve the problems. To judge his knowledge and originality and capacity for application of laboratory data in designing chemical plants and to determine the level of his proficiency at the end of the course.

**Title**: COMPREHENSIVE VIVA  
**Code**: CHE 409  
**Semester**: 8th  
**Credits**: 01

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<td>Contact Hours</td>
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The viva-voce examinations will be comprehensive and covering mainly chemical engineering and technology subjects covered during all the semester including the Eight Semester.

**Title**: Financial Accounting  
**Code**: CHM 402  
**Semester**: 7th  
**Credits**: 4

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**THEORY**

**Note for the Examiner**

The question paper should be divided into Section A and Section B. Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION-A**

**Accounting**: Accounting and its functions; Accounting as an information system; Basic Accounting
Concepts and Accounting Conventions; Accounting Principles; Generally Accepted Accounting Policies (GAAP); Accounting Standards.

**Branches of Accounting:** Financial Accounting; Cost Accounting; Management Accounting; Accounting Equation; Accounting Structure; Types of Accounts.

Rules regarding Journal Entries; Recording of Journal Entries; Ledger Posting; Cash book; Trial Balance; Preparation of Final Accounts; Trading Account; Profit & Loss Account; Balance Sheet; Treatment of Adjustments into trial balance.

**Meaning of Management Accounting:** Nature; Scope; Objectives; Functions of Management Accounting; Relationship between Financial and Management Accounting; Meaning of Financial Statement; Importance and Limitations of Financial Statement; Meaning and Objectives of Financial Statement Analysis; Limitation of Financial Analysis.

**Tools of financial analysis:** Ratio analysis; Common size statements; Trend analysis; Fund flow and cash flow statement.

**Cost Accounting:** Meaning, scope and classification of costs; Absorption costing; Marginal costing and break even analysis; Use of cost data in managerial decision making.

**Cost Control Techniques:** Preparation of budgets and their control; Zero base budgeting; Standard costing and variance analysis; Responsibility Accounting; Target costing; Kaizen costing; Activity based costing.

**SECTION-B**

**Responsibility Accounting:** Meaning; Steps involved in Responsibility Accounting; Responsibility Centre; Advantages of Responsibility Accounting.

**Price Level Accounting:** Meaning; Methods or Techniques of Price Level Accounting; Advantages; Disadvantages.

**Social Accounting:** Concept of Social Cost Benefit Analysis; Meaning of Social Accounting; Need; Social Accounting Approaches.

**Human Resource Accounting:** Meaning; Need; Methods of Human Resource Accounting; Objections Against Human Resource Accounting; HRA in India.

**Books Recommended:**

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<thead>
<tr>
<th>Title</th>
<th>Business Environment</th>
<th>Credits</th>
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**THEORY**

Note for the Examiner: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION – A**

**Economic Environment:** Economic Environment of Business, Non- economic Environment of Business- Politico legal environment of business, Critical elements of socio – cultural environment;
emerging rural sector in India and Indian Business; Social responsibility of business, Consumerism in India; Techniques of Environmental Scanning; Environmental Scanning of some important industries.

**Economic Planning in India:** Objectives, Strategies and Evaluation of current Five Year Plan; Public Sector in India; Privatization and Disinvestment; New Economic Policy-Liberalization and Structural Adjustment Programmes; Economic Systems.

**SECTION – B**

**Economic Policies in India:** Monetary Policy as an instrument of growth; Fiscal Policy and Indian business; Industrial Policy and Industrial Licensing in India; EXIM Policy, MRTP Act, FERA, FEMA.

**International Economic Environment:** Globalization - concept and emergence of globalization; Foreign Direct Investment; Benefits and Problems from MNCs; WTO-its role and functions, implications for India; Devaluation of Rupee

**Suggested Readings:**
1. Ruddar Datt & K.P.M. Sundaram: Indian Economy, Sultan Chand and Sons.

**DEPARTMENTAL ELECTIVES**

**THEORY**

| Note for the Examiner | Note for the Paper setter: The question paper should be divided into Section A and Section B. Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section. |

**PETROLEUM PROCESSING ENGINEERING (Theory)**

**SECTION- A**

Introduction to petroleum industry, world petroleum resources, petroleum industry in India. Origin, exploration & drilling of petroleum crude. Transportation of crude and products.
Crude pretreatment: Refining and distillation of petroleum crude, composition and classification of petroleum crude, methods of evaluation: ASTM, TBP and EFV distillation. Properties and specifications of petroleum products such as LPG, gasoline, naphtha, kerosene, diesel, lubricating oils and waxes.

**SECTION- B**

Separation Processes: Design and operation of topping and vacuum distillation units and tube still furnaces. Solvent extraction processes for lube oil base stock and for aromatics from naphtha and kerosene steams, solvent dewaxing.
Conversion Processes: Thermal cracking: visbreaking and coking processes, catalytic cracking, thermal reforming and catalytic reforming, alkylation, polymerization, isomerisation and hydroprocessing.
Safety and pollution considerations in refineries.

**Practicals**
1. To plot ASTM distillation curve for gasoline, diesel oil.
2. To determine Flash point (Closed – cup) and smoke point for kerosene.
3. To determine Aniline point, Diesel Index and cetane number for diesel oil.
4. To determine pour point and cloud point for furnace oil and diesel oil.
5. To determine viscosity at different temperatures using Ostwald viscometer for hydrocarbon solvents.
6. To determine softening point and penetration number for asphalt and grease samples.
7. To determine viscosity index of lubricating oil by Redwood viscometer.
8. To determine water content in petroleum products by Dean and Starks method.

Books:

PROCESS INSTRUMENTATION (Theory)

SECTION-A
General Concept: Need and classification of measurements and instruments, Basic and auxiliary functional elements of a measurement system.
Static and Dynamic Characteristics of Instruments:
Static Characteristics: Range and span, accuracy and static error, reproducibility and drift, sensitivity and dead zone.
Dynamic Characteristics: Speed of response and lag, fidelity and dynamic error, dead time.
Temperature measurement:
Thermocouples, metal resistance thermometers and thermistors, optical and radiation pyrometers, radiation receiving elements.
Pressure measurement:
Use of manometers, Bourdon gauge, bellows type gauge. Vacuum measurement – Mcleod gauge, thermoionic type ionization gauge, pirani vacuum gauge. Measurement of pressure in corrosive fluids: Diaphragm seal, liquid seal and purge system.

SECTION-B
Liquid level measurement:
Direct measurement of liquid level – Float & tape liquid level gauge, float and shaft liquid level unit, hydraulic remote transmission of liquid level.
Level measurement in open vessels: Bubbler system, diaphragm box system, air trap system. Level measurement in pressure vessels – Differential pressure manometer, use of liquid seals with a manometer, displacement float liquid level gauge. (6 Hrs.)
Measurement of viscosity, conductivity, humidity and pH.
Density measurement – liquid level method, displacement meter and hydrometer.
Measurement of weight – spring scale, pneumatic force meter and hydrostatic force meter.
Process Instrumentation – Recording instruments, indicating and signaling instruments, control centre, transmission of instrument reading, instrumentation diagrams.

Books Recommended:
1. Eckman, Donald P. : Industrial Instrumentation, CBS Publisher and Distributors, Indian Reprint 2004.
INDUSTRIAL SAFETY & HAZARDS (Theory)

SECTION-A

Definition, identification, classification and assessment of various types of hazards in work-place environment, protective and preventive measures in hazard control. 

Toxic Chemicals: maximum allowable concentrations and other standards. Biological threshold limit values.


SECTION-B


Case Studies of typical hazardous industries.

Books Recommended:


PLANT UTILITIES (Theory)

SECTION-A

Importance of Process utilities in Chemical Plant.

Compressed air and Vacuum: Reciprocating air compressors, vacuum pumps, air receivers, piping systems.

Steam: Boiler, steam handling and distribution steam nozzles.

SECTION-B

Refrigeration: Air refrigeration cycle, vapour compression cycle, liquification processes.

Power Generation: Internal Combustion engines. Gas turbines, steam power plants.


Books Recommended:

Petrochemical Technology (Theory)

SECTION-A

General Introduction: Definition, history and economic perspective of petrochemical industry, raw materials for petrochemical industry—petroleum, natural gas, coal, bio-mass, agro-residues, etc.

First Generation Petrochemicals: Petrochemicals based on aliphatic, olefinic, acetylene, aromatics, etc. Hydrocarbons—processing and applications.


SECTION-B

Nylon Monomers, Polyester Monomers, Styrene, Other Monomers—Bisphenol A, Epichlorohydrin, disocyanates, Pentaerythritol, etc.—properties, process technologies and applications.

Third Generation Petrochemicals: Important Polymers such as Polyethylene, Polypropylene and their Copolymers and other Derivatives Rubbers, Diene Polymers, Styrene Polymers, Vinyl Polymers and Condensation Polymers—properties, process technologies and applications.

Books Recommended:


OPEN ELECTIVES

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<th>THEORY</th>
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<tr>
<td>Note for the Examiner</td>
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Production and Operation Management (Theory)

SECTION - A

Operations Management: Concepts; Functions


Process Selection: Project, Job, Batch, Mass & Process types of Production Systems; Product-Process Mix

Facility Location: importance; Factors in Location Analysis; Location Analysis Techniques.
**Facility Layout:** Objectives; Advantages; Basic Types of Layouts.

**Capacity Planning:** Concepts; Factors Affective Capacity; Planning; Capacity Planning Decisions.

**Production Planning & Control (PPC):** Concepts; Objectives; Functions

**Work Study:** Productivity; Method Study; Work Measurement.

**SECTION - B**

**Materials Management:** Concepts; Objectives

**Introduction to modern Productivity techniques:** Just in time; Kanban System; Total quality management & six sigma.

**Functions Purchasing Management:** Objectives; Functions; Methods; Procedure

**Stores Management:** Types of Stores; Functions; Coding Methods

**Value Analysis:** Concepts

**Inventory Management:** Concepts; Classification; Objectives; Factors Affecting

Inventory Control Policy; Inventory Costs; Basic EOQ Model; Re-order Level; ABC Analysis.

**Maintenance Management:** Concepts; Objectives; Functions; Types of Maintenance.

**Suggested Readings:**
1. Nair: Production & Operation Management, Tata McGraw Hill
2. Adam & Ebert: Production & Operation Management, Prentice Hall India
5. SN Chary: Production & Operations Management, Tata McGraw Hill

**FUEL CELL TECHNOLOGY (Theory)**

**Section-A**
Overview of fuel cells: Low and high temperature fuel cells;
Fuel cell thermodynamics - heat, work potentials, prediction of reversible voltage, fuel cell efficiency.
Fuel cell reaction kinetics - electrode kinetics, overvoltages, Tafel equation, charge transfer reaction, exchange currents,
Electrocatalyses - design, activation kinetics,
Fuel cell charge and mass transport - flow field, transport in electrode and electrolyte.

**Section-B**
Fuel cell characterization: - in-situ and ex-situ characterization techniques, i-V curve, frequency response analyses; Fuel cell modeling and system integration: - 1D model - analytical solution and CFD models. Balance of plant; Hydrogen production from renewable sources and storage; safety issues, cost expectation and life cycle analysis of fuel cells.

**Books Recommended**

**Text books:**

**Reference Books:**
Note for the Examiner:

Note for the Paper setter: The question paper should be divided into Section A and Section B. Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

### SECTION- A

**Introduction to Macro Economics:** Definition, Scope, Importance and Limitations of Macroeconomics  
**National Income (NI) Accounting:** Meaning of NI and Circular Flow of NI (in Four sector economy), Stock and flow concept, NI at Current Price and NI at Constant Price, Various concepts of NI (GNP, GDP, NNP, NDP), Personal Income, Disposable Income, Methods for measurement of NI, Difficulties in measurement of NI  
**Theory of Income and Employment:** Keynes’ consumption function, Investment function, Keynesian theory of Income and employment

### SECTION- B

**Money:** Definition and Functions, Stocks of Money (M1, M2, M3 and M4), Inflation, Meaning of Inflation, Deflation, Stagflation and Causes of inflation, Measures to Control Inflation  
**Business cycle:** Meaning, characteristics and phases  
**Monetary policy:** Meaning, Objectives and Tools  
**Fiscal policy:** Meaning, Objectives and Tools  
**Balance of Payments:** Meaning, Structure, Causes of Disequilibrium and Methods of Correcting Disequilibrium

### Recommended Books

- Macro Economics by D.M.Mithani (Himalaya Publication)  
- Macro Economics by R. Cauvery (S.Chand Publication.)

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### INTERNATIONAL BUSINESS MANAGEMENT (Theory)

#### SECTION – A


**Strategies and Structures of International Business:** International Business Strategies, Organizational Structures and Strategies of International Business, International Entry Strategies, Strategies Alliances, Role of GATT / WTO.

#### SECTION – B


**Emerging Issues:** Emerging Economies, e-business, Operating in a Borderless World, Export Promotion, Export documents and Procedures, Export Risk Insurance; Major problems of Indian Export Sector.

**Suggested Readings:**


TOTAL QUALITY MANAGEMENT (Theory)

SECTION- A


SECTION- B

Service quality Management and cost of Quality : Products and services , classification of services , service quality , measuring service quality , prevention costs , appraisal costs , internal and external failure costs , cost of quality models , India’s quality journey so-far , quality related priorities of Indian Companies

Statistical quality/process control – Meaning and significance of statistical process control, Introduction to Quality control and its benefits , Variation in processes , Process capability – meaning ,significance, measurement and its analysis ; control charts for variables and attributes , establishing and interpreting control charts , Reliability concepts – Definition , reliability in series and parallel , product life characteristics curve , Total productive maintenance (TPM) , Business process improvement principles. Concept of acceptance sampling , sampling by attributes , single and double sampling plans , inspection by samples ,AQL ,LTDP , consumers and producer’s risk , construction and use of operating characteristic curves , using of standard sampling tables , sampling by variables , continuous sampling plans , vendor ratings. Six Sigma : meaning , seven magnificent quality tools , introduction to experimental method and Taguchi method , Concept ,Process and application of Quality Function deployment (QFD ) , building House of quality , FMEA analysis-stages ,design , process and documentation , benchmarking
Text books:
8. Total Quality Management, Subburaj, TMH

Reference Books:
1. Probability and Reliability with Statistics, Trivedi, PHI
2. Statistical Quality Control, M. Mahajan
3. TQM in Service Sector, R.P. Mohanty and R.R. Lakhe
4. Total Quality Management, Arora and Kataria

Course Assessment Methods
Assessment will consist of the following components
3. Mid-Term
e. One best of two minor tests (50% of Mid-term marks)
f. Assignments (20% of Mid-term marks)
g. Class Surprise Tests/ Quizzes/Presentations/Class Participation (20% of Mid-term marks)
4. End-Term

Course Outcomes
The students are able to
1. Understand total quality management and its various tools
2. Evaluate quality systems and business excellence models
3. Implement SQC

NANO TECHNOLOGY (Theory)

SECTION-A

Introduction: Plenty of room at the bottom-Feynman’s concept, evolution of ultra-fine materials, the missing link between conventional laws in physics and chemistry and new theories.

Building Blocks of Nanotechnology: covalent architecture, coordinated architecture and weakly bound aggregates, interactions and topology

Chemical Properties: The effect of nanoscale metals on chemical reactivity, effect of nanostructure on mass transport, metal nanocrystallites support on oxides, supported nanoscale catalysts.

General principles for synthesis of monodispersed nanoparticles, metals and intermetallics, Ceramics, composites, nanoparticles, colloids/Micelles/vesicles/Polymers/glasses, Crystalline, and zeolite hosts.

Review of fundamental behaviour of 0-D(nanoclusters), 1-D(nanowires), 2-D(thin film multilayers), and 3-D(bulk nanostructures) materials. Introduction to size dependent phenomenon in nanostructure for various applications, specific production techniques like chemical vapor deposition, arc ignition etc. Formation of clusters and nanoparticles from supersaturated vapor and selected properties, sputtering and thermal evaporation and laser methods. Synthesis of nanoparticles by chemical routes.

SECTION-B

Approaches to production: Top down and bottom up, Mechanical attrition, high energy ball milling, and mechanical attrition, nanocomposites by mechano-chemistry, mechanism of grain size reduction, property of microstructure relationships.

Characterization techniques: Tools in nanotechnology: Scanning electron microscopy(SEM), Transmission electron microscopy and high resolution(TEM), energy dispersive spectroscopy (EDX), Atomic force microscopy(AFM), Magnetic force microscopy(MFM), Chemical Force
Microscopy (CFM), Focused ion beam, nanolithography, powder x-ray diffractometry, UV visible.

**Nanomaterials:** CNTs, Polymer Nanocomposites nanoceramics, nanometals, nanopolymers, structures-properties-applications, Quantum dots. Concepts Bio-Nanotechnology. **Applications:** Nanotherapeutics, Molecular diagnostics, tissue engineering, nanopumps, nanorobotics cells, molecular motors, nanomembranes, Organic molecular based computers, bionanodevices (sensors & actuators).

**Books Recommended**

2. *Nanotechnology – An introduction to nanostructure of technique* by Michel Kohler and Wolfgang Frittsche 2004- Wiley VCH
3. *Springer Handbook of Nanotechnology* by Bharat Bhushan
5. *Nanostructures and Nanomaterials* by G. Cao, Imperial College Press, 2004
6. *Introduction to Nanotechnology* by Owen and Poole, Wiley
7. *Nano-materials* by A. K. Bandopadhyay, New Age International

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**POLYMER SCIENCE AND ENGINEERING (Theory)**

**SECTION A**

**Chemistry of polymers:**
Monomers, functionality, degree of polymerizations, classification of polymers, glass transition, melting transition, criteria for rubberiness, Polymerization methods: addition and condensation; their kinetics, copolymerization, monomer reactivity ratios and its significance, kinetics, different copolymers, random, alternating, azeotropic copolymerization, block and graft copolymers, techniques for copolymerization-bulk, solution, suspension, emulsion.

**Polymer Characterization:**
Solubility and swelling, concept of average molecular weight, determination of number average, weight average, viscosity average and Z-average molecular weights, polymer crystallinity, analysis of polymers using IR, XRD, thermal (DSC, DMTA, TGA), microscopic (optical and electronic) techniques.

**SECTION B**

**Polymer Technology:**
Polymer compounding-need and significance, different compounding ingredients for rubber and plastics, crosslinking and vulcanization

**Polymer processing:**
Compression molding, transfer molding, injection molding, blow molding, reaction injection molding, extrusion, pultrusion, calendaring, rotational molding, thermoforming, rubber processing in two-roll mill, internal mixer.

**Books Recommended:**

NINTH SEMESTER

Paper Title: FINANCIAL MANAGEMENT (Theory)
Paper Code : MBA-CHE 5901 Max. Marks : 50 Credits: 4 Time: 3 hours
Course Duration: 42 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B
Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set.
The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION-A

Introduction to Financial Management: Meaning; Scope; Finance Function; Financial Goals;
Agency Problem; Relationship of Finance with Accounts and Economics.
Sources of Finance: Features; Advantages and Limitations of Equity Shares; Preference
Shares;Debentures; Term-Loans; Right Issue, Venture Capital, Private Equity GDR, ADR.
Cost of Capital: Meaning; Calculation of Cost of Debt Capital; Equity Capital; Preference Capital;
Retained Earnings; Weighted Average Cost of Capital.
Capital Structure: Meaning; Determinants; Assumptions; Net Income and Operating Income
Approach; Traditional Position; M-M Position; EBIT and EPS Analysis; Capital Structure and
Taxation.
Leverage Analysis : Meaning; Types; Estimation of Financial; Operating and Combined Leverage;
Relation of Financial Leverage with Risk and Return.
Management of Working Capital : Meaning of WC; Need of WC Management; Determinants of
WC; Operating Cycle; Estimation of WC; Working Capital Financing; Trade Credit, Bank finance,
commercial paper, factoring, money market instruments.

SECTION-B

Cash Management: Meaning; Facets of Cash Management; Motives for Holding Cash; Optimal
Cash Balance; Short-term and Long-Term Cash Forecasting.
Receivable Management: Meaning; Credit Policy Variable; Credit Evaluation; Credit Decisions;
Control of Account Receivable.
Inventory Management: Meaning; Need to hold Inventory; Objective of Inventory Management;
Inventory Investment Analysis; Inventory Control System.
Capital Budgeting: Meaning; Basic Principles of Costs and Benefits; Investment Criteria; Pay back
Method; Accounting Rate of Return method; Net Present Value Method; Benefit-Cost Ratio; Internal
Rate of Return; Capital Rationing; Introduction to Basic Techniques of Risk Analysis in Capital
Budgeting.
Dividend Decisions: Meaning and Types of Dividend; Issues in Dividend Policy; Traditional Model;
Walter Model; Gordon Model; Miller and Modigliani Model; Bonus Shares and Stock Splits.
Corporate Restructuring : Meaning and forms of corporate restructuring, merger and amalgamation
takeover and acquisition, types or forms of mergers and takeovers, their benefits and motives.

Suggested Readings:
GROUP-A

Paper Title: FUNCTIONAL SUBJECT-1/FUNCTIONAL SUBJECT-2 (Theory)
Students will have to opt for TWO functional subjects, from GROUP-A.

Paper Code: MBA-CHE 5902  Max. Marks: 50  Credits: 4  Time: 3 hours
Paper Code: MBA-CHE 5903  Max. Marks: 50  Credits: 4  Time: 3 hours

Course Duration: 42 Lectures of one hour each.
Note for the Paper setter: The question paper should be divided into Section A and Section B
Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set.
The students will be required to attempt 5 questions selecting at least 2 from each section.

1. MARKETING RESEARCH AND CONSUMER BEHAVIOUR

SECTION – A
Introduction to Consumer Behavior: Introduction, Applications of consumer behavior, Consumer behavior and marketing strategy, Consumer decision process, situational characteristics and consumption behavior, consumer decision making process, Post purchase behavior.

Factors Influencing Consumer Behavior: Consumer specific factors influencing buying behavior, psychological processes (motivation, perception, learning and memory) affecting consumer behavior; the buying motive, high involvement and low involvement buying situations, Consumer behavior in adapting new products, participants in buying decisions; Group influence- Definition, types of group (primary, secondary, formal etc.), Family influence, roles, FLC application.

SECTION – B
Introduction to Marketing Research: Meaning, scope and importance of marketing research; defining the market research problem and developing an approach, research design formulation, Rating Scales Juster, Likert, Semantic Differential, Thurston, Attitude Scales, preparing a written research report, organization of the report, ethical issues in marketing research.

Applications of marketing research: Research design classification, product research- developing products, specifications and attributes; Concept of test marketing; advertising research, Market and sale analysis research, sales forecasting, demand measurement.

Suggested Readings:-
7. A. Parasuraman et.al.: Marketing Research, Biztantra.

2. INVESTMENT ANALYSIS AND PORTFOLIO MANAGEMENT

SECTION-A
Introduction to Investment Management: Concept and objectives of investment, Difference between Investment and Speculation, Investment and Gambling, Meaning of Investment

**Risk and Return:** Concept of Risk, Components of Investment Risk, Measurement of Risk through Standard Deviation, Regression Equation, Covariance, Concept of Return, Expected Yield, Actual Yield, Holding Period Yield, Relationship between Risk and Return


**Efficient Market Theory:** Random walk; Weak form, semi-strong and strong form of market; Empirical tests; Comparison between random walk.

**Economic and Industry Analysis:** Macro-Economic Analysis, Forecasting, Industry Analysis, Sensitivity of Business Cycle, Industry Life Cycle Analysis, Porter Model of Assessment of Profit Potential of Industries

**Company Analysis:** Meaning of Company Analysis, Strategy Analysis, Accounting Analysis, Financial Analysis, and Estimation of Intrinsic Value.

**SECTION-B**


**Portfolio Theory:** Merits of Diversification: Diversification and Portfolio Risk, Portfolio Return and Risk, Calculation of Portfolio Risk, Efficient Frontier for two securities, Efficient Frontier for n-securities, Optimal Portfolio.

**Portfolio Analysis:** Concept of Traditional and Modern Portfolio Analysis, Markowitz Theory Risk – Return Optimisation, Single Index Model, Beta Generation in Efficient Frontier, Three securities Model, Interactive Risk through Covariance, Correlation Co-efficient, Sharpe’s Model.

**Portfolio Selection:** Concept of Portfolio Selection, Optimal Portfolio, Objectives, Risk and Investor Preferences, Investment Constraints, Cut-off Rate and New Securities, Efficient Frontier and Portfolio Selection, Beta, Traditional Portfolio Building, Capital Market Theory, CAPM, SML, Forms of CAPM, Zero Beta CAPM, Tax adjusted CAPM, Arbitrage Pricing Theory.

**Portfolio Revision:** Meaning, Need, Techniques of Portfolio Revision, Formula Plans, Rules Regarding Formula Plans, Constant Rupee Value Plan, Constant Ratio Plan, Variable Ratio Plan, Modifications, Rupee Averaging Technique.

**Suggested Readings:**
2. Frank J Fabozzi.: Investment Management, Prentice Hall - Gale
8. V. K. Bhalla: Investment Management, Sultan Chand and Sons.

**3. INTERNATIONAL HUMAN RESOURCE MANAGEMENT**

**Section A**

**International HRM:** Concept, Defining International HRM, Differences between domestic and international HRM, Variables moderating the difference between domestic and International HRM, Developments leading to global HRM, Issues in global organizations, Management of external environment, Relevance and importance of IHRM.
Sustaining International Business Operations: Approaches to staffing- ethnocentric, polycentric, geocentric, regiocentric, reasons and types of international assignments, role of expatriates, role of non expatriates.

Recruiting and selecting staff for international assignments: issues in staff selection, reasons for expatriate failure, factors moderating performance, selection criteria.

Training and development: Role of expatriate training, effective pre-departure training programmes, effectiveness of pre departure training, developing staff through international assignments.

Compensation: Objectives of International compensation, key components of international compensation programme, approaches to international compensation.

Re-entry and Career Issues: Repatriation Process, individual reactions to re-entry, Multinational responses, designing repatriation programme.

Section B

HRM in host country context: standardisation and adaptation of work practices, retaining, developing and retrenching staff.

Industrial Relations: Key issues in international Industrial relations, trade unions and international industrial relations, response of trade unions to multinationals.

Performance Management: Multinational performance management, performance management of international employees, Performance appraisal of international employees, Appraisal of HCNs.

Culture and IHRM: Concept of Culture, Cross Cultural Studies, Hofstede’s Model of National Culture

Cross Cultural Communication: Cultural Variables Affecting Communication, Managing Cross-Cultural Communication.

IHRM Trends and future challenges: International business ethics and HRM, research issues and theoretical developments in international HRM.

GHRM in Select Countries: America, Japan, China, Korea, Africa, Europe, India.

Suggested Readings:-

4. SUPPLY CHAIN MANAGEMENT

SECTION – A

Introduction to Supply Chain Management:Definition; Scope & Importance of Supply Chain Management; Key drivers Of the SCM; Features of Supply Chain Management; Supply Chain Network – 1st Tier , 2nd Tier; Network decisions in SCM; Suppliers and Customers; Customer Service Dimension (Seven “R” Principles, Service after sale, Customer delight)

Role of Logistics in Supply Chains: Definition of Logistics Management; Scope and role of Transportation, Traffic & transportation; Relationship between transportation and other business functions; Transport Economics: Distance – volume-density, Freight Cost, Handling, Liability, market factors; Third party logistics (3 PL) & fourth party logistics service provider (4 PL), Logistics equipment; Reverse Logistics, Government rule & regulations related to Logistics; Purchase Cycle, Make or Buy, Price analysis, Negotiations.
SECTION – B

Inventory Management: Inventory Control, Planning & Managing Inventories; Warehouse Management (Receipt, issue, storage and preservation, stock verification, Inbound and outbound distribution operations); Order Management; Competitive advantage through logistics and supply chain management; Responsive Supply Chain; Supply chain process integration, performance measurement; Value Chain, Value System and Supply Chain.

Planning demand and supply: Planning & Sourcing in Supply Chain, Demand forecasting, Type and Time horizon of forecast and category of forecasting, aggregate planning; Financial issues in Supply Chain - Macro and micro view, Asset management, Du Pont Model, Supply Chain Costing; Decision environment in SCM; Global supply chain perspectives - New business models, role of IT in SCM.

Suggested Readings:
4. RP Mohanty: Supply Chain Management-Theories and Practice, Biztantra.
5. Robert B. Handfield, Ernest L. Nicholas, Jr.: Introduction to Supply Chain Management, Pearson Education.

GROUP-B

Paper Title: FUNACTIONAL SUBJECT-3/FUNCTIONAL SUBJECT-4 (Theory)
Students will have to opt for TWO functional subjects, from GROUP-B.

Paper Code : MBA-CHE 5904
Max. Marks : 50
Credits: 4
Time: 3 hours

Paper Code : MBA-CHE 5905
Max. Marks : 50
Credits: 4
Time: 3 hours

Course Duration: 42 Lectures of one hour each.
Note for the Paper setter: The question paper should be divided into Section A and Section B
Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set.
The students will be required to attempt 5 questions selecting at least 2 from each section.

1. ADVERTISING AND SALES MANAGEMENT

SECTION – A

Introduction to Advertising: Advertising- an element in Marketing Mix, role and importance; Difference between advertisement and publicity; Advertising as a means of communication, Setting advertising objectives, DAGMAR approach to setting objectives; Media, selection, measurement of effectiveness of Media, Preparing advertising plan, Developing message, writing copy, advertising appeals and per-testing and post teaching copy Media decisions, media strategy and scheduling decisions; Planning and managing advertising campaigns
**Integrated marketing Communications:** Different types of advertising, public relations; advertising budget and relevant decisions; Advertising agencies; their role and importance; management problems of agencies; client-agency relations; advertising in India, problems and prospects. Role of Integrated Marketing Communications (IMC), Designing, Objectives Setting and Budgeting for IMC programs, developing effective communications, Managing Mass Communications: Events, experiences and public relations, measuring media.

**SECTION – B**

**Sales Management:** Sales organization, Sales Functions and its relationship with other marketing functions, The external relationship of the Sales Department e.g. with distributors; Government and Public, Functions and qualities of a Sales Executive, Environment Routing and Scheduling, International Sales Management.

**Salesmanship:** Theoretical aspects of Salesmanship, the process of selling, Sales forecasting methods, Sales budget, Sales force management; Recruitment, Selection, Training, Motivation and Compensation of the fields sales force and sales executive; The evaluation and control of sales force, Sales Territories, Sales Quotas.

**Suggested Readings:**
2. Raghuvir Singh: Advertising-Planning and Implementation, Prentice Hall India.

2. **STRATEGIC COST MANAGEMENT**

**SECTION – A**


**Value Analysis:** Meaning of Value Analysis and value addition, Strategic Application of Value Chain Analysis.

**Strategic Positioning Analysis:** Critical Success Factors and SWOT Analysis.

**Cost Volume Profit Analysis:** Cost Behaviour Pattern, Cost Estimation Methods, Assumptions of CVP Analysis, Applications of CVP, Break Even Analysis, CVP Analysis in the choice of Cost Structure, Multiple Product Analysis.

**SECTION – B**


**Responsibility Accounting:** Activity based Responsibility Accounting, Behavioural aspects of responsibility accounting, Transfer Pricing.
Productivity improvement: Various tools and techniques including Kaizen and Six Sigma.

Suggested Readings:

3.   ORGANISATIONAL DEVELOPMENT

SECTION – A

Introduction to OD: Definitions of Organizational Development (OD), Growth and Relevance of OD.  
History of OD: The Laboratory Training; Survey Research and Feedback; Action Research; Socio-technical and Socio-clinical Parallels, Second Generation OD.  
Underlying Assumptions and Values: Assumptions about people as individuals, Assumptions about people in groups and about leadership, Assumptions about people in organizational systems, Assumptions that relate to values in the client organization, Values and belief system of behavioral scientist change agents.


OD Interventions - An Overview: A definition of OD interventions, nature of OD interventions, the major families of OD interventions, classification schemata for OD interventions.  
Team Interventions: Teams and Work Groups - Strategic Units of Organizations, Team Building Interventions, the Family Group Diagnostic Meeting, The Family Group Team-Building Meeting, Role Analysis Technique Intervention, Role Negotiation Technique, Responsibility Charting, the Force Field Analysis Technique, Gestalt Orientation to Team Building.  

SECTION – B

Structural Interventions and OD: Suggested Criteria for Congruency-incongruency with OD, Job Design, Quality Circles, MBO and Appraisal, Socio technical Systems and Work Restructuring, Quality of Work Life Projects.  
The Collateral Organization: A Task Force with a Difference, Physical Settings and OD, Similarities and Differences between OD and selected structural interventions.  
The Role and Style of the OD Practitioner: External and Internal Practitioner, Competencies of an OD Practitioner, OD Practitioner Styles, the OD Practitioner and his role in Intervention Process,
forming the practitioner-client relationship, Professional Values and Ethics for OD professionals, Ethical Guidelines and Dilemmas.

**Suggested Readings:**
5. D.R. Brown and D. Harvey: An Experiential Approach to OD, Pearson Education.

### 4. ENTERPRISE RESOURCE PLANNING

**SECTION – A**

Issues, Concerns and Purchasing: Disadvantages of ERP Solutions, users, developers, customers of ERP, purchasing or outsourcing, planning, purchasing and selection of ERP, Managing implementation partners; ERP strategy options and risk mitigation.

**SECTION – B**
Implementation of ERP: Implementation plan of ERP, Methods and tools, business process mapping, gap analysis, risks and dependencies, project timeline plan, project organization plan, structure and coding, data migration and historical record, prototype testing, user training program, knowledge management, disaster recovery plan, RDBMS, data communication system, hardware requirements, sample system architecture.

ERP Project Success and failure: Introduction to ERP Project success and failure with case studies, Current and future ERP market, key players and market shares, market issues; Continuous business improvement in ERP.

**Suggested Readings:**
SECTION – A

Meaning and importance of communication in business: Process, types of communication: formal and informal and their characteristics, essentials of effective business communication, Channels of communication, their effectiveness, limitations, Barriers of communication, approaches to effective Communication, Negotiation skills and participating decision making in Management

Presentations, Book Reviews and Summaries


Listening Skills: Listening to Specific Information, Identifying Main Issues, Seeing Beyond the Surface

Team Assignment: Effects of Competition on Individual and Group Behaviour, Competitive and Collaborative Team Behaviour; Team/ Group Dynamics, Team Assignment

SECTION – B

Stress Management: Symptoms of Stress, Coping Approaches.

Report Writing: Process, Structure and Layout. Principles of clear writing, often misused words, applications and requests, positive and negative responses to requests, routine messages, memos, organizing meetings, preparation of agenda and minutes, business etiquette, telephone etiquette, e-mail etiquette.

Interpersonal Skills: Negotiations, social skills, assertive skills, cross-cultural communications.

Leadership Skills: Concepts of leadership, leadership styles, insights from great leaders.

Suggested Readings:
2. Poe & Fruchling: Basic Communication, AITBS.
5. Baugh, Frayer & Thomas: How to write first class Business Correspondence, Viva Books.

Paper Title : WORKSHOP ON DEVELOPING ENTREPRENEURIAL SKILLS (Practical)
Paper Code: MBA-CHE 5952 Max. Marks: 25 Credit: 1

SECTION – A

Entrepreneurship: Entrepreneurship and Economic Development; Entrepreneurial Competencies; Factor Affecting Entrepreneurial Growth - Economic, Non-Economic Factors; EDP Programmes; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs;

Identification and Product Selection: Entrepreneurial Opportunity Search and Identification; Criteria to Select a Product; Conducting Feasibility Studies; Project Finalization; Sources of Information.

SECTION – B

Small Enterprises and Enterprise Launching Formalities : Definition of Small Scale; Rationale; Objective; Scope; Role of SME in Economic Development of India; SME; Registration; NOC from Pollution Board; Machinery and Equipment Selection; Project Report Preparation; Preparing Project
Role of Support Institutions and Management of Small Business: Director of Industries, DIC, SIDO, SIDBI, SIDC, SISI, NSIC, SFC; Marketing Management, Production Management; Finance Management; Human Resource Management; Export Marketing Concept of Venture Capital.

Suggested Readings:
TENTH SEMESTER

Paper Title: STRATEGIC MANAGEMENT (Theory)

Introduction: Conceptual framework of strategic management, Strategic formation process, Approaches to strategies decision making, Pitfalls, Techniques for improvement, Mission.

Objectives and Goals: Significance, Characteristics and formation of Missions, Objectives and Goals, Porter’s five force model and strategies groups, Competitive advantage, Distinctive Competencies.

Organizational Analysis through Internal Scanning: Value chain analysis, Organization structure and culture, Various strategies issues.


Building and Restructuring Business: Start up route, Acquisition, Joint venture, Merger, Takeover, Restructuring, Retrenchment, Divestment, Harvest, Liquidation, Turnaround strategy.


Implementation of Strategy: Designing of structure, Designing of effective control system, ISO 9000, Strategic system, Strategic change process.


Suggested Readings:
Paper Title: BUSINESS ENVIRONMENT (Theory)

Paper Code : MBA-CHE 51002  Max. Marks : 50  Credits: 4  Time: 3 hours
Course Duration: 42 Lectures of one hour each.
Note for the Paper setter: The question paper should be divided into Section A and Section B
Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set.
The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION – A

Economic Environment: Economic Environment of Business, Non-economic Environment of Business- Politico legal environment of business, Critical elements of socio-cultural environment; emerging rural sector in India and Indian Business; Social responsibility of business, Consumerism in India; Techniques of Environmental Scanning; Environmental Scanning of some important industries.

Economic Planning in India: Objectives, Strategies and Evaluation of current Five Year Plan; Public Sector in India; Privatization and Disinvestment; New Economic Policy-Liberalization and Structural Adjustment Programmes; Economic Systems.

SECTION – B

Economic Policies in India: Monetary Policy as an instrument of growth; Fiscal Policy and Indian business; Industrial Policy and Industrial Licensing in India; EXIM Policy, MRTP Act, FERA, FEMA.

International Economic Environment: Globalization - concept and emergence of globalization; Foreign Direct Investment; Benefits and Problems from MNCs; WTO-its role and functions, implications for India; Devaluation of Rupee

Suggested Readings:
1. Ruddar Datt & K.P.M. Sundaram: Indian Economy, Sultan Chand and Sons.

Paper Title: PRODUCTION AND OPERATION MANAGEMENT (Theory)

Paper Code : MBA-CHE 51003  Max. Marks : 50  Credits: 4  Time: 3 hours
Course Duration: 42 Lectures of one hour each.
Note for the Paper setter: The question paper should be divided into Section A and Section B
Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set.
The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION - A

Operations Management: Concepts; Functions
Process Selection: Project, Job, Batch, Mass & Process types of Production Systems; Product-Process Mix

Facility Location: importance; Factors in Location Analysis; Location Analysis Techniques.
Facility Layout: Objectives; Advantages; Basic Types of Layouts.
Capacity Planning: Concepts; Factors Affective Capacity; Planning; Capacity Planning Decisions.
Production Planning & Control (PPC): Concepts; Objectives; Functions
Work Study: Productivity; Method Study; Work Measurement.

SECTION - B

Materials Management: Concepts; Objectives
Introduction to modern Productivity techniques: Just in time; Kanban System; Total quality management & six sigma.
Functions Purchasing Management: Objectives; Functions; Methods; Procedure
Stores Management: Types of Stores; Functions; Coding Methods
Value Analysis: Concepts
Inventory Management: Concepts; Classification; Objectives; Factors Affecting Inventory Control Policy; Inventory Costs; Basic EOQ Model; Re-order Level; ABC Analysis.
Maintenance Management: Concepts; Objectives; Functions; Types of Maintenance.

Suggested Readings:
1. Nair: Production & Operation Management, Tata McGraw Hill
2. Adam & Ebert: Production & Operation Management, Prentice Hall India
5. SN Chary: Production & Operations Management, Tata McGraw Hill

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THEORY

Note for the Examiner: The question paper should be divided into Section A and Section B. Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION- A

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

Trade Marks: Purpose and function of trade marks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

SECTION- B

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, False advertising.

UNIT - V:

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.
International overview on intellectual property, international - trade mark law, copy right law, international patent law, international development in trade secrets law.

**Recommended Books**

Intellectual property right, Deborah, E. Bouchoux, cengage learning.

Intellectual property right - Unleashing the knowledge economy, prabuddha ganguli, Tata Mc Graw Hill Publishing Company Ltd.

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**Paper Title**: FUNCTIONAL SUBJECT-5 (Theory)

**Students will have to opt for ONE functional subject from the following.**

**Paper Code**: MBA-CHE 51005  Max. Marks: 50  Credits: 4  Time: 3 hours

**Course Duration**: 42 Lectures of one hour each.

**Note for the Paper setter**: The question paper should be divided into Section A and Section B

Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

1. INTERNATIONAL BUSINESS MANAGEMENT

**SECTION – A**


**SECTION – B**


**Suggested Readings**:

2. INTERNATIONAL FINANCIAL MANAGEMENT

SECTION – A

Internationalization of financial function: International financial management - An overview, Objectives of international firm and impact of risk; Financial function in multinational corporation.


Managing Short-term Assets and Liabilities: International working capital management, Investment of international money market; Euro currency and other important international money market, International ranking and payment settlement mechanism.

SECTION – B


Emerging Issues in International Finance: Charges in international business & trade and its impact on international finance; Recent changes in international money and capital markets; Impact of international tax on international finance.

Suggested Readings:-

3. INDUSTRIAL RELATIONS AND LABOUR LAWS

SECTION – A

Overview of Industrial Relations: Concept of IR, Nature of IR, Objectives of IR, Evolution of IR in India, Theories of IR, Systems approach to IR.

Trade Unionism: Concept of Trade Unions , Functions of Trade Unions , Approaches , Structures of Trade Unions.

The Trade Unions Act, 1926: Trade Union, Registration of Trade Unions, Rights and Liabilities of registered trade unions.

Grievance Handling: Grievance, Causes/Sources of Grievances, Grievance Redressal Machinery, Legislative Aspects of the Grievance Redressal Procedure in India, Domestic enquiry.


SECTION – B

The Workmen's Compensation Act, 1923: Workman, employer’s liability to pay compensation, disablement, amount of compensation.

Tripartite and bipartite bodies: Workers Participation in Management.


Industrial Relations and emerging scenario: Industrial Relations and technological change, International Labour Organisation (ILO): Objectives and Structure, Future of Industrial Relations

Standing Orders Act, 1948: Standing orders, certification of draft standing orders, duration and modification of certified orders.

Employee’s State Insurance Act, 1948: Contribution, principle employer, immediate employer, different benefits.

Suggested Readings:
6. S.N. Dhayani: Industrial Relations System, Sultan Chand and Sons

4. ADVANCED PRODUCTION MANAGEMENT

SECTION – A

Operations Management: Concepts, Functions


Facility Location: Importance, Factors in Location Analysis, Location Analysis Techniques.

Facility Layout: Objectives, Advantages, Basic Types of Layouts.


Production Planning & Control (PPC): Concepts, Objectives, Functions.


SECTION – B

Materials Management: Concepts, Objectives.
Introduction to modern Productivity techniques: Just in time, Kanban System, Total quality management & Six Sigma.

Functions Purchasing Management: Objectives, Functions, Methods, Procedure.

Stores Management: Types of Stores, Functions, Coding Methods

Value Analysis: Concepts.

Inventory Management: Concepts, Classification, Objectives, Factors Affecting Inventory Control Policy, Inventory Costs, Basic EOQ Model, Re-order Level, ABC Analysis.

Maintenance Management: Concepts, Objectives, Functions, Types of Maintenance.

Suggested Readings:
1. N.G. Nair: Production & Operation Management, Tata McGraw Hill
2. Everett E. Adam & Ronald J. Ebert: Production & Operation Management, Prentice Hall India
6. Gaither: Operations Management, Thomas Learning
8. M.M. Verma: Materials Management, Sultan Chand and Sons

Paper Title: FUNCTIONAL SUBJECT-6 (Theory)
Students will have to opt for ONE functional subject from the following.

Paper Code: MBA-CHE 51006 Max. Marks: 50 Credits: 4 Time: 3 hours
Course Duration: 42 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

1. INDUSTRIAL AND RURAL MARKETING

SECTION-A

Introduction to Industrial Marketing: Definition of Industrial & Consumer Product, Basis of Classification; Difference between Industrial & Consumer Marketing, Concept of Derived Demand, Classification of Industrial Consumers, Industrial goods, Key Characteristics of Organizational Buying Process.


SECTION – B

**Promotion Strategies:** Advertising, Sales Promotion, Communication in Rural Marketing - Language and Culture Distribution Strategies for rural Marketing and channels of distribution, Role of Co-operative, Government, financial institutions, public sector undertaking, regulated markets and public distribution systems, Intervention of IT in rural Markets

**Suggested Readings:**
2. Francis Cherunilam: Industrial Marketing Text and Cases, Himalaya Publishing House

**2. MANAGEMENT OF FINANCIAL SERVICES**

**SECTION – A**

**Financial Services:** Introduction of Financial Intermediaries and Financial Services, Organisation of the Financial Service Industry, Various Financial Intermediaries, Recent Development in Financial Services, Financial Services in India.


**Depository Services:** Introduction to Depository Services, Depository Participants in India, Role of NSDL and CDSL, Difference Between NSDL and Bank, Services Offered By Depository Participants, Products Offered By Depository Participants, Process of Dematerialisation, Difference Between Physical and Electronic Holding of Securities.

**Broking:** Broking Services and Trading in Equity Broking and Trading in Debt;

**Mutual Funds:** Concept of Mutual Funds, Types of Mutual Funds, Advantages, Structure of Mutual Funds and tax treatment, SEBI and Mutual Funds Regulations;

**Insurance Services:** Introduction, Types of Insurance, Life Products, Non-Life Products.

**SECTION – B**

**Debt Securitisation and Corporate Advisory Services:** Introduction, Securitisation as a funding Mechanism, Securitisation of Mortgaged and Non-Mortgaged Assets Issue Management;

**Credit Rating:** Meaning of Credit Rating, Process of Credit Rating, and Factors affecting Rating, Types of Rating, Advantages and Disadvantages of Credit Rating, Methodology of Credit Rating, Credit Rating Agency Regulation Act 1974, Credit Rating in India.


**Leasing:** Definition, Types of Leases, Advantages, Disadvantages, Leasing and Commercial Banking Sector, Risk in Leasing, Lease Proposal Analysis, Comparison Between Lease and Hire Purchase, Legal Aspects of leasing, Taxation Aspects of leasing, Lease Accounting and Reporting.
Housing Finance: Introduction to Housing Finance, Housing Finance Schemes, Procedure of Loan-disbursement, Legal Framework of Housing Finance; Credit Cards, Types, Settlement Process, Mechanism, Member Establishment, Member Affiliates.

Factoring: Meaning, Forms, Functions, Legal Aspects, Evaluation.

Suggested Readings:
7. Satish K. Matta: Management of Financial Institutions and Services, Vrinda Publications

3. PERFORMANCE MANAGEMENT

SECTION – A

Performance Management: Definition, Disadvantages of poorly implemented Performance Management (PM) Systems - aims and role of PM Systems, Characteristics of ideal PM Systems.


Performance Management Theatre: Concept, pillars of Performance management theatre, planning managee performance and development, monitoring managee performance and development, annual stocktaking.

Planning Managee Performance and Development: Setting objectives, Organisational and individual performance plans, Components of Managee performance and development plan, setting mutual expectations and performance criteria

Monitoring and Mentoring Managee Performance and Development: Introduction, Supervision, Objectives and Principles of Monitoring, monitoring process, periodic reviews, problem solving, process and principles of managee development, role efficacy.

SECTION – B

Annual Stocktaking: Stock taking performance, stock taking discussions, stocktaking potential, Tools for stocktaking potential (assessment centres, 360 degree feedback, managee career development window).

Appraising for Recognition and Rewards: Pros and cons of appraising, appraiser and appraisee concerns, common rating errors, purposes for appraising, methods of appraisal, implementing the appraisal system

Reward Management: Definition, foundations of reward management, financial and non-financial rewards, factors affecting level of pay, developing reward processes.

Pay Structures: fixed vs variable pay, graded pay structures, broadening, developing pay structures.

Pay systems: team based pay, performance related pay, short term incentives, long term incentives, executive compensation, international compensation, benefits.

Suggested Readings:
4. PRODUCTIVITY MANAGEMENT

SECTION – A

Introduction: The concept of productivity; Needs for productivity culture; Management and productivity; Factors affecting productivity; Efforts in productivity management; Organizational effectiveness and productivity.

Sources of productivity: Labor, capital, efficiency in use of labor and capital, productivity and standard of living.

Measurement of Productivity: Productivity cycle; Productivity measurement and its need; Total productivity mode; Limitations of partial measures of productivity; Productivity evaluation in organizations; Productivity and industrial relations.

Productivity and business cycles: Cyclical pattern of labor productivity, market impact on productivity.

SECTION – B

Productivity and Planning: Productivity planning and improvement concepts, Strategies for productivity; International productivity management and experience; Indian experience in productivity.

Productivity and price trends: Factors influencing relative price, relationship of price and output.

Productivity and Government Policies: Productivity trends in selected industries engineering, fertilizers, textiles and in energy, Impact of government policies on productivity.

Productivity differences among countries: International differences in labor productivity, role of central planning errors and business cycles on productivity.

Suggested Readings:
3. Chandra: Dynamics of Productivity, South Publisher.
5. Prokopenko: Productivity Management, Oxford & IBH.

Paper Title: SEMINAR ON CORPORATE GOVERNANCE
Paper Code: MBA-CHE 51051 No Credit Qualifying

SECTION – A

Corporate Governance: Introduction, Overview.

Corporate Board: Attributes, Duties, Responsibilities, Liabilities; Shaping Directorial Competence and Board Effectiveness; Financial Institutions and Nominee Directors.

Corporate Governance and Security: Corporate Disclosure and Investor Protection, Corporate Restructuring and Revival of Sick Units, Corporate Reputation, Corporate Legitimacy and Corporate Crime.
SECTION – B

Culture: An introduction; organization culture - Building and maintaining; Managing cultural diversity in organization; Indian culture characteristics.

General Issues regarding Corporate Governance: Takeover Codes, Corporate Board Committees, Globalisation and Corporate Governance, Emerging Trends in Corporate Governance.

Suggested Readings:
2. C.V. Baxi: Corporate Governance, Excel books.
4. Dr. S. Singh: Corporate Governance, Excel books.
5. Swami (Dr.) Parthasarathy: Corporate Governance, biz tantra.
7. Jill Solomon: Corporate Governance & Accountability, Wiley India.
10. Subhash Chandra Das: Corporate Governance in India, Prentice Hall India.

Paper Title : WORKSHOP ON INFORMATION TECHNOLOGY AND SYSTEMS (Practical)
Paper Code: MBA-CHE 51052  Max. Marks : 25  Credit: 1

SECTION – A


MS Word: Introduction to MS Word, Basic Formatting, Legal Numbering, Understanding Styles, Sections, Section Breaks, Headers and Footers, Complex Legal Documents, Tables in the Legal Environment, Track Changes, Compare & Merge Documents, Send for Review and Comments, Troubleshooting Track Changes , Mail Merge Tool.

SECTION – B

MS Excel: Spreadsheets and their uses in business, Excel basics, Rearranging, Worksheets, Excel formatting techniques, using formulas and functions.

Data Structures and Descriptive Statistics: Data Tables, Built-In Functions available from the AutoSum Tool, Additional Statistical Functions, The Analysis ToolPack, Frequency Distributions, Charts, Graphs, and Tables, Pivot Tables and Charts, One-Sample t-Test, One-Way Between-Groups ANOVA, Correlation and Regression, Chi-Square Tests


Computer Security: Introduction, Malicious Programs, Cryptography, Digital Signature, Firewall, Users Identification and Authentication, Security Awareness and Policies

Suggested Readings:

Paper Title: RESEARCH PROJECT (Practical)
Paper Code: MBA-CHE 51053
Qualifying Credits: 2

Paper Title: COMPREHENSIVE VIVA-VOCE (Practical)
Paper Code: MBA-CHE 51054
Max. Marks: 50 Credits: 2