Model Curriculum for UG Degree Course in Logistics and Supply Chain Management

2023

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION
Nelson Mandela Marg, Vasant Kunj, New Delhi 110070
www.aicte-india.org
AICTE Model Curriculum for UG Degree Course in Logistics and Supply Chain Management
Model Curriculum For
UG Degree Course
in
Logistics and Supply Chain
Management
(Engineering & Technology)

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PREFACE

Taking cognizance of growing concern about quality of technical education in India, AICTE in its 49th council meeting held on 14.03.2017 approved a package of measures for improving quality of technical education - Revision of Curriculum, Mandatory Internship, and Student Induction Program were amongst the few.

AICTE constituted committee of academia industry experts to prepare model curriculum of UG Course in Robotics and Artificial Intelligence Engineering. During the development of curriculum, the employability and employment opportunities for graduates, future ready workforce who will be skilled enough to handle the rapid growth in the field of Robotics and Artificial Intelligence Engineering were kept in mind.

AICTE has introduced mandatory internship in the new curriculum which will equip the students with practical understanding and training about industry practices in a suitable industry or organization. In the course of development of model curriculum, the committee took feedback of industry experts on the draft curriculum and accordingly modified the draft before finalization. This exercise has ensured that essential emphasis on industry requirements and market trends, employability and problem solving approach is given.

After due deliberations, the scheme and syllabus have been formulated. Salient features of this model curriculum are enumerated as under:

- Reduced number of credits.
- Introduction of Student Induction Program.
- Well defined learning objectives & outcomes for each course.
- Inclusion of courses on socially relevant topics.
- Built-in flexibility to the students in terms of professional elective and open elective courses.
- Mandatory internship to equip the students with practical knowledge and provide them exposure to real time industrial environments.
- Virtual Labs.
- Mapping of Courses to its equivalent NPTEL/SWAYAM Course.
- Course on ‘Entrepreneurship and Startups’ to encourage entrepreneurial mindset.
- Introduction of Design Thinking and Universal Human Value course.

I gratefully acknowledge the time and efforts of the members of the working group and other committee members.

Special thanks to Prof. Prof. T. G. Sitharam, Chairman; Dr. Abhay Jere, Vice-Chairman; and Prof. Rajive Kumar, Member Secretary, AICTE who all have been instrumental and encouraging throughout the process of development of this model curriculum.

I appreciate the dedication put by the Dr. Dinesh Singh, Director (P&AP), Sh, Vamsi Krishnan, Deputy Director (P&AP), Mr. Rakesh Kumar Pandit, Young Professional (P&AP); and other office staff of AICTE.

(Dr. Mamta Rani Agarwal)
Advisor – I (P&AP)
## Committee for Model Curriculum

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<th>Designation &amp; Organization</th>
</tr>
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<tr>
<td>1</td>
<td>Prof. S G Deshmukh</td>
<td>IIT Delhi, Chairman</td>
</tr>
<tr>
<td>2</td>
<td>Prof. Manoj Kumar Tiwari</td>
<td>IIM Mumbai, Vice Chairman</td>
</tr>
<tr>
<td>3</td>
<td>Prof. Debjit Roy,</td>
<td>Professor of Operations and Decision Sciences,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IIM Ahmedabad, Member</td>
</tr>
<tr>
<td>4</td>
<td>Sh. Swapan Malpani</td>
<td>VP, Supply chain, Cipla, Member</td>
</tr>
<tr>
<td>5</td>
<td>Prof. P K Jain</td>
<td>Director, IIT BHU, Member</td>
</tr>
<tr>
<td>6</td>
<td>Mrs Ruma Kishore Digital</td>
<td>SCM executive, HUL, Member</td>
</tr>
<tr>
<td>7</td>
<td>Sh. Siddharth Bhagat</td>
<td>Senior executive Amazon , Member</td>
</tr>
<tr>
<td>8</td>
<td>Dr. Mamta R. Agarwal</td>
<td>Adviser-I, P&amp; AP,AICTE, Coordinator</td>
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Engineering Graphics
Computer Programming: C and Python
English for Communication Skills
Design Thinking
IDEA Lab Workshop

SEMESTER – II
Mathematics-II
Introduction to Management Science
Environmental Studies
Basic Economics
Engineering Mechanics
Electrical Engineering Fundamentals
Workshop Practice

SEMESTER – III
Introduction to Probability and Statistics
Operations Research-I
Managerial Accounting
Data Analytics for managerial decisions
Introduction to logistics and supply chain management
Naya Bharat and Logistics
Universal Human Values-II: Understanding Harmony and Ethical Human Conduct

SEMESTER – IV
Operations Research-II
Introduction to Multimodal logistics
Material Handling and Packaging
Financial management for supply chain leaders
Global Logistics and Supply Chain Management
Introduction to AI and Machine Learning
Indian Knowledge System

SEMESTER – V
Supply Chain Risk Modeling
Logistics Network Design and Optimization
Port Terminal Management
Air cargo management
<table>
<thead>
<tr>
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<td>Procurement and Supplier Relationship Management</td>
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<td>Artificial Intelligence</td>
<td>101</td>
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<td>Quantum Computing</td>
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<td>Cyber Security</td>
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<td>Robotics</td>
<td>107</td>
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<td>Virtual Reality</td>
<td>109</td>
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<td>Data Sciences</td>
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GENERAL COURSE STRUCTURE
& CREDIT DISTRIBUTION
GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit:

<table>
<thead>
<tr>
<th>Course Type</th>
<th>Credit</th>
</tr>
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<tbody>
<tr>
<td>1 Hr. Lecture (L) per week</td>
<td>1 Credit</td>
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<tr>
<td>1 Hr. Tutorial (T) per week</td>
<td>1 Credit</td>
</tr>
<tr>
<td>1 Hr. Practical (P) per week</td>
<td>0.5 Credit</td>
</tr>
<tr>
<td>2 Hours Practical (P) per week</td>
<td>1 Credit</td>
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</tbody>
</table>

B. Range of Credits:
In the light of the fact that a typical Model Four-year Under Graduate degree program in Engineering has about 160 credits, the total number of credits proposed for the Four-year B. Tech/B.E. in Logistics and Supply Chain Management (Engineering & Technology) is kept as 160.

C. Course code and definition:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Lecture</td>
</tr>
<tr>
<td>T</td>
<td>Tutorial</td>
</tr>
<tr>
<td>P</td>
<td>Practical</td>
</tr>
<tr>
<td>C</td>
<td>Credits</td>
</tr>
<tr>
<td>BSC</td>
<td>Basic Science Courses</td>
</tr>
<tr>
<td>ESC</td>
<td>Engineering Science Courses</td>
</tr>
<tr>
<td>HSMC</td>
<td>Humanities and Social Sciences including Management courses</td>
</tr>
<tr>
<td>PCC</td>
<td>Professional core courses</td>
</tr>
<tr>
<td>PEC</td>
<td>Professional Elective courses</td>
</tr>
<tr>
<td>OEC</td>
<td>Open Elective courses</td>
</tr>
<tr>
<td>LC</td>
<td>Laboratory course</td>
</tr>
<tr>
<td>MC</td>
<td>Mandatory courses</td>
</tr>
</tbody>
</table>

D. Structure of UG Program in Logistics and Supply Chain Management:
The structure of UG program in Logistics and Supply Chain Management shall have essentially the following categories of courses with the breakup of credits as given:

<table>
<thead>
<tr>
<th>S.No</th>
<th>Category</th>
<th>Credit Breakup for LSCM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Humanities and Social Sciences including Management courses</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>Basic Science courses</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>Engineering Science courses including workshop, drawing, basics of electronics/electrical/mechanical/computer etc.</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>Professional core courses</td>
<td>76</td>
</tr>
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</table>
Objective of the program

The objective of the B. Tech program is to equip students with the necessary knowledge and skills for the design, management, and enhancement of supply chains in general to any sector. The curriculum covers various subjects such as operations management, logistics, transportation, warehousing, inventory management, supply chain planning and forecasting, purchasing and supplier management, information technology for logistics and supply chain management, quality management, and project management. Employers across various industries, such as manufacturing, retail, transportation, and logistics, have a strong demand for graduates with a B. Tech in Logistics and Supply Chain Management (L&SCM). Additionally, individuals may choose to pursue careers in academia, consulting, or government.

Distinct feature of the program

The B.Tech in logistics, and supply chain management (L&SCM) curriculum stands out due to its focus on a systemic approach to supply chain management. Students gain practical knowledge through internships and capstone projects, where they learn to apply technological solutions to supply chain problems. Students in the Bachelor of Technology in Logistics and Supply Chain Management (LSCM) program acquire knowledge and skills in utilizing technology to enhance the efficiency and effectiveness of supply chain operations. Students have the chance to apply their theoretical knowledge in practical settings.

First Semester

The courses in the first semester of the B.Tech program in Logistics and Supply Chain Management are highly relevant today. Mathematics-I equips students with essential problem-solving skills vital for optimizing supply chain operations. Physics provides a foundational understanding of physical principles applicable to goods, transportation, and handling. Indian Knowledge System fosters an appreciation for regional influences on supply chains. Engineering Graphics aids in designing efficient layouts. Computer Programming in C and Python addresses data analysis needs. English for Communication Skills enhances
collaboration abilities. Extracurricular activities promote well-being and teamwork, all essential skills in the logistics and supply chain industry. Together, these courses provide a strong foundation for addressing the challenges of modern supply chain management.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>L-T-P</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mathematics-I</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Physics</td>
<td>2-0-2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Introduction to Biological Systems</td>
<td>2-0-2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Engineering Graphics</td>
<td>2-0-2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Computer Programming: C and Python</td>
<td>2-0-2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>English for Communication Skills</td>
<td>2-0-2</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Extra-curriculum (Yoga, Cultural, Sports, NSS and NCC)</td>
<td>0-0-2</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Design Thinking</td>
<td>0-0-2</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>IDEA Lab Workshop</td>
<td>2-0-4</td>
<td>0</td>
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</tbody>
</table>

**Total** 15-0-16 20 credits

**Second Semester**

In the second semester of the B.Tech programme in Logistics and Supply Chain Management, Mathematics-II, Introduction to Management Science, and Environmental Studies teach advanced problem-solving, data-driven decision-making, and sustainability. Engineering Mechanics and Electrical Engineering Fundamentals teach equipment and automation, while Basic Economics explains market dynamics. Maintenance and comprehension of equipment are taught in workshops. These courses equip students for modern logistics and supply chain management and its associated challenges.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>L-T-P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mathematics -II</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Introduction to Management Science</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Environmental Studies</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Basic Economics</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Engineering Mechanics</td>
<td>2-0-2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Electrical Engineering Fundamentals</td>
<td>2-0-2</td>
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<tr>
<td>7</td>
<td>Workshop Practice</td>
<td>0-1-2</td>
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</table>

**Total** 16-1-6 20 credits

**Third Semester**

Courses such as “Introduction to Probability and Statistics”, “Operations Research-I”, “Managerial Accounting”, “Data Analytics for Managerial Decisions”, “Introduction to Logistics and Supply Chain Management”, and “Naya Bharat and Logistics” are especially pertinent during the third semester of the Bachelor of Technology programme in Logistics and Supply Chain Management. Skills in data analysis, optimisation, making sound financial decisions, and managing supply chains are taught to students, so equipping them for a successful career in the fast-paced logistics and supply chain industry.
Fourth Semester

The syllabus of the fourth semester of the Bachelor of Technology programme in Logistics and Supply Chain Management encompasses a selection of courses that are highly pertinent to the contemporary demands of the industry. The course “Operations Research-II” aims to develop and improve the optimisation abilities required for tackling complicated problems. The significance of effective and environmentally friendly transportation is explored in the course “Introduction to Multi-Modal Logistics”. The primary objective of “Material Handling and Packaging” is to examine and analyse the implementation of efficient logistics strategies. The course titled “Financial Management for Supply Chain Leaders” aims to develop the participants’ proficiency in finance and leadership abilities. The field of “Global Logistics and Supply Chain Management” encompasses the examination and management of difficulties that arise on a worldwide scale. The course titled “Introduction to Artificial Intelligence and Machine Learning” provides an overview of advanced technologies. These courses aim to equip students with the necessary skills and knowledge to thrive in the dynamic and constantly changing logistics and supply chain business.

Fifth Semester

The fifth semester of the B.Tech in Logistics and Supply Chain Management offers contemporary, relevant courses. “Supply Chain Risk Modelling” teaches students how to identify and mitigate supply chain risks, a critical skill in our interconnected and uncertain world. “Logistics Network Design and Optimisation” covers the growing need for efficient and sustainable supply chain networks, aligning with environmental and cost-effective logistics solutions. Due to the present focus on international trade and logistics, “Port Terminal
Management” and “Air Cargo Management” acknowledge the importance of multimodal transportation hubs in global goods flow. The continuously changing supply chain requires an entrepreneurial mindset, which “Innovation and Entrepreneurship” develops. Students learn cutting-edge technologies in the “Simulation and Digital Twin Lab” to optimise supply chains with digital tools and simulations. Students learn how to succeed in the dynamic and competitive profession of logistics and supply chain management by addressing industry challenges and opportunities in these courses.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>L-T-P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Supply Chain Risk Modeling</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Logistics Network Design and Optimization</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Port terminal management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Air Cargo management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Innovation and Entrepreneurship</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Simulation and digital twin lab</td>
<td>0-0-6</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Open Elective I</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>Indian Constitution ^</td>
<td>3-0-0</td>
<td>0</td>
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<td><strong>Total</strong></td>
<td></td>
<td><strong>21-0-6</strong></td>
<td><strong>21 credits</strong></td>
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</tbody>
</table>

**Sixth Semester**

The courses offered in the sixth semester like “Maritime Logistics” and “Blockchains and Smart Contracts for Digital Supply Chains” cover crucial aspects of contemporary logistics. The terms “Procurement and Supplier Relationship Management” and “Warehouse and Distribution Management” highlight crucial operational aspects. “Enterprise Lab” gives students hands-on experience. By addressing current industry demands, these courses prepare students for success in the dynamic and competitive field of logistics and supply chain management.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>L-T-P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Maritime logistics</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Blockchains, and smart contracts for Digital Supply Chains</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Procurement and Supplier Relationship Management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Warehouse and Distribution Management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Enterprise Lab</td>
<td>0-0-6</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Open Elective II</td>
<td>3-0-0</td>
<td>3</td>
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<tr>
<td>7</td>
<td>Professional Elective I</td>
<td>3-0-0</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>18-0-6</strong></td>
<td><strong>21 credits</strong></td>
</tr>
</tbody>
</table>

**Seventh Semester**

The seventh semester of the B.Tech programme in Logistics and Supply Chain Management provides students with courses that prepare them for career success. “Digital Innovation and Technology in Supply Chain Management” examines how technology improves supply chain efficiency and competitiveness. “Intermodal Transportation and Containerization” covers
modern transportation technology and practises, focusing on containerized shipping and multimodal transportation. “Global Trade Management” teaches international logistics concepts to prepare students for global logistics management. "SDGs and Logistics” promotes sustainable logistics practises in line with the SDGs. In addition, “Elective II” lets students specialise in personal or industry-relevant subjects. Finally, the “Internship” gives students excellent hands-on experience to confidently and competently face logistics and supply chain management difficulties.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>L-T-P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Digital Innovation and Technology in Supply Chain Management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Intermodal transportation and containerization</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Global trade management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>SDGs and Logistics</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Open Elective II</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Professional Elective II</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Internship</td>
<td>0-0-6</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>18-0-6</strong></td>
<td><strong>21 credits</strong></td>
</tr>
</tbody>
</table>

Eight Semester

The students in the eighth semester of the B.Tech program in Logistics and Supply Chain Management participate in three critical components: “Industrial Training/Internship” for hands-on experience, “B.Tech Seminar” for research and industry insights, and “Project Work/Dissertation” for in-depth investigation. These factors are extremely important for future success in the industry, linking theory and practice.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>L-T-P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Industrial Training/Internship</td>
<td>0-0-4</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>B.Tech Seminar</td>
<td>0-0-6</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Project Work/Dissertation</td>
<td>0-0-14</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>Professional Elective III</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>3-0-24</strong></td>
<td><strong>15 Credits</strong></td>
</tr>
</tbody>
</table>
INDUCTION PROGRAM

The Essence and Details of Induction program can also be understood from the ‘Detailed Guide on Student Induction program’, as available on AICTE Portal, (Link: https://www.aicteindia.org/sites/default/files/Detailed%20Guide%20on%20Student%20Induction%20program.pdf). For more, Refer Appendix II.

<table>
<thead>
<tr>
<th>Induction program (mandatory)</th>
<th>Three-week duration</th>
</tr>
</thead>
</table>
| Induction program for students to be offered right at the start of the first year. | • Physical activity  
• Creative Arts  
• Universal Human Values  
• Literary  
• Proficiency Modules  
• Lectures by Eminent People  
• Visits to local Areas  
• Familiarization to Dept./Branch & Innovations |

A. Mandatory Visits/ Workshop/Expert Lectures:

- It is mandatory to arrange one industrial visit every semester for the students of each branch.
- It is mandatory to conduct a One-week workshop during the winter break after fifth semester on professional/ industry/ entrepreneurial orientation.
- It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry.

B. Evaluation Scheme (Suggestive only):

a. For Theory Courses:

(The weightage of Internal assessment is 40% and for End Semester Exam is 60%)
The student has to obtain at least 40% marks individually both in internal assessment and end semester exams to pass.

b. For Practical Courses:

(The weightage of Internal assessment is 60% and for End Semester Exam is 40%)
The student has to obtain at least 40% marks individually both in internal assessment and end semester exams to pass.

c. For Summer Internship / Projects / Seminar etc.
Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.
Note: The internal assessment is based on the student’s performance in mid semester tests (two best out of three), quizzes, assignments, class performance, attendance, viva-voce in practical, lab record etc.

C. Mapping of Marks to Grades
Each course (Theory/Practical) is to be assigned 100 marks, irrespective of the number of credits, and the mapping of marks to grades may be done as per the following table:

<table>
<thead>
<tr>
<th>Range of Marks</th>
<th>Assigned Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>91-100</td>
<td>AA/A+</td>
</tr>
<tr>
<td>81-90</td>
<td>AB/A</td>
</tr>
<tr>
<td>71-80</td>
<td>BB/B+</td>
</tr>
<tr>
<td>61-70</td>
<td>BC/B</td>
</tr>
<tr>
<td>51-60</td>
<td>CC/C+</td>
</tr>
<tr>
<td>46-50</td>
<td>CD/C</td>
</tr>
<tr>
<td>40-45</td>
<td>DD/D</td>
</tr>
<tr>
<td>&lt; 40</td>
<td>FF/F (Fail due to less marks)</td>
</tr>
<tr>
<td>-</td>
<td>FR (Fail due to shortage of attendance and therefore, to repeat the course)</td>
</tr>
</tbody>
</table>

*******
SEMESTER WISE STRUCTURE
## SEMESTER- I

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>L-T-P</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3 WEEKS COMPULSORY INDUCTION PROGRAM (UHV-I)</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Mathematics-I</td>
<td>2-0-2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Physics</td>
<td>2-0-2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Introduction to Biological Systems</td>
<td>2-0-2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Computer Programming: C and Python</td>
<td>2-0-2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>English for Communication Skills</td>
<td>2-0-2</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Extra-curriculum (Yoga, Cultural, Sports, NSS and NCC)</td>
<td>0-0-2</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Design Thinking</td>
<td>0-0-2</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>IDEA Lab Workshop^</td>
<td>2-0-4</td>
<td>0</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td>15-0-16</td>
<td>20 credits</td>
</tr>
</tbody>
</table>

^ represent “Audit Course”. i.e Compulsory but non-credit course

## SEMESTER-I I

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>L-T-P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mathematics -II</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Introduction to Management Science</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Environmental Studies</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Basic Economics</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Engineering Mechanics</td>
<td>2-0-2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Electrical Engineering Fundamentals</td>
<td>2-0-2</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Workshop Practice</td>
<td>0-1-2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>16-1-6</td>
<td>20 credits</td>
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</table>

## SEMESTER-III

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>L-T-P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to Probability and Statistics</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Operations Research-I</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Managerial Accounting</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Data Analytics for managerial decisions</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Introduction to logistics and supply chain management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Naya Bharat and Logistics</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Universal Human Values</td>
<td>2-1-0</td>
<td>3</td>
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<tr>
<td><strong>Total</strong></td>
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<td>20-1-0</td>
<td>21 credits</td>
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### SEMESTER-IV

<table>
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<th>Course</th>
<th>L-T-P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Operations Research-II</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Introduction to Multi-Modal Logistics</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Material Handling and Packaging</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Financial management for supply chain leaders</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Global Logistics and Supply Chain Management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Introduction to AI &amp; Machine Learning</td>
<td>3-0-0</td>
<td>3</td>
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<tr>
<td>7</td>
<td>Indian Knowledge System</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>24-0-0</strong></td>
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### SEMESTER-V

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>L-T-P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Supply Chain Risk Modeling</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Logistics Network Design and Optimization</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Port terminal management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Air Cargo management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Innovation and Entrepreneurship</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Simulation and digital twin lab</td>
<td>0-0-6</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Open Elective I</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>Indian Constitution^</td>
<td>3-0-0</td>
<td>0</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>21-0-6</strong></td>
<td><strong>21 credits</strong></td>
</tr>
</tbody>
</table>

^ represent “Audit Course”.

### SEMESTER-VI

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>L-T-P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Maritime logistics</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Blockchains, and smart contracts for Digital Supply Chains</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Procurement and Supplier Relationship Management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Warehouse and Distribution Management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Enterprise Lab</td>
<td>0-0-6</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Open Elective II</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Professional Elective I</td>
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<td>3</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>18-0-6</strong></td>
<td><strong>21 credits</strong></td>
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### SEMESTER-VII

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>L-T-P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Digital Innovation and Technology in Supply Chain Management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Intermodal transportation and containerization</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Global trade management</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>SDGs and Logistics</td>
<td>3-0-0</td>
<td>3</td>
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<tr>
<td>5</td>
<td>Open Elective III</td>
<td>3-0-0</td>
<td>3</td>
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<tr>
<td>6</td>
<td>Professional Elective II</td>
<td>3-0-0</td>
<td>3</td>
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<tr>
<td>7</td>
<td>Internship</td>
<td>0-0-6</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>18-0-6</strong></td>
<td><strong>21 credits</strong></td>
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### SEMESTER-VIII

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>L-T-P</th>
<th>Credit</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Industrial Training/Internship</td>
<td>0-0-4</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>B.Tech Seminar</td>
<td>0-0-6</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Project Work/Dissertation</td>
<td>0-0-14</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>Professional Elective III</td>
<td>3-0-0</td>
<td>3</td>
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<td></td>
<td><strong>Total</strong></td>
<td><strong>3-0-24</strong></td>
<td><strong>15 Credits</strong></td>
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</table>
SEMESTER – I
B.TECH (Logistics and Supply Chain Management- 4 Years) - (UG)

Mathematics-I

<table>
<thead>
<tr>
<th>BSC -01</th>
<th>Mathematics-I</th>
<th>3L:0T:0P</th>
<th>3 credits</th>
</tr>
</thead>
</table>

Course Objectives:

- To provide students with a foundational understanding of linear algebra and calculus.
- To develop logical reasoning and thinking through mathematical principles to improve problem-solving skills.
- To give students the ability to apply mathematical concepts to real-world problems and engineering challenges.

Course Content:

The following are the primary focuses of this course:

Matrices, Systems of linear equations, Determinants, Eigenvalues and eigenvectors Matrices, Complex numbers, Functions of one variable, Limits, continuity, and differentiability, Mean value theorems, Indeterminate forms, Taylor’s theorem, Functions of two variables, Partial derivatives, Total derivatives, Tangent planes and normal lines, Maxima, minima, and saddle points, Double and triple integrals, Vectors, Stoke’s theorem, Green’s theorem and Gauss divergence theorem and their applications.

Course Outcomes:

- Students will demonstrate that they understand algebra and calculus.
- Capacity to use mathematical reasoning to solve complicated problems.
- Use mathematical concepts to analyze and effectively resolve engineering challenges

Textbooks


********
Physics

<table>
<thead>
<tr>
<th>BSC-02</th>
<th>Physics</th>
<th>2L:0T:2P</th>
<th>3 credits</th>
</tr>
</thead>
</table>

Course Objectives:

- To build analytical and experimental abilities to observe, quantify, and explain physical phenomena.
- To offer a thorough understanding of the fundamental laws and principles regulating the physical universe.
- To improve problem-solving abilities by applying physics principles.

Course Content:

The following are the primary focuses of this course:


Course Outcomes:

- Students will be able to perform experiments and data analysis to comprehend physical events.
- Students will also have a solid understanding of the fundamental physics principles and theories.
- Utilise physics to address problems and scenarios that arise in the real world.

Textbooks


********
Introduction to Biological Systems

Course Objectives:

• Provide students with a fundamental knowledge of biological systems, such as organisms, cells, and ecosystems.
• Develop the scientific inquiry and analytical thinking abilities required to understand biological concepts.
• Understand the importance of biological systems in a variety of fields and daily life.

Course Content:

The following are the primary focuses of this course:

Cell Theory and Cell Structure, metabolism, and cellular respiration, cell membrane structure, Laws of inheritance, DNA structure, and replication, Darwin’s theory of evolution, Biodiversity conservation and preservation, the flow of energy in ecosystems, human body system, biotechnology, genetic engineering, scientific advancement in biological systems, biological research, and methods.

Course Outcomes:

• Understand the underlying concepts of biological systems and their interdependence.
• The ability to analyze biological occurrences and processes critically.
• Use biological concepts to comprehend real-world scenarios and issues.

Textbooks

• General Biology by Dr. Uma Devi Koduru, Khanna Publishing Company Private Limited.
• Essentials of Biology (2020) by Sylvia S. Mader and Michael Windelspecht, 6th edition
• Biology: Concepts and Investigations (2017) by Mariëlle Hoefnagels

********

Engineering Graphics

Course Objectives:

• Learn technical drawing techniques such as orthographic projections, isometric perspectives, and 3D modelling.
• Practise producing and modifying engineering drawings using computer-aided design (CAD) software
Course Content:
The following are the primary focuses of this course:

Introduction to Engineering Graphics, Drawing instruments and materials, drawing conventions, Lettering, and dimensioning, Orthographic Projections, first and third-angle projections, projections of points, lines, and planes, Projections of solids, Various types of sectional views, full, half, and partial sections, revolved and removed sections, isometric projections, principles of isometric projection, construction of isometric views, isometric projections of solids, principles of perspective projection, construction of perspective views, Perspective projections of solids, geometric constructions, construction of basic geometric shapes, construction of conic sections, construction of special curves.

Course Outcomes:
- Expertise in developing precise engineering drawings utilising manual and computer-based methods.
- Communicate engineering ideas and thoughts using standardized and exact graphics.

Textbooks

- K. Venugopal and V. Prabhu Raja (2023), A textbook of Engineering Drawing

********

Computer Programming: C and Python

| ES-02 | Computer Programming: C and Python | 2L:0T:2P | 3 credits |

Course Objectives

- Learn the fundamentals of C and Python programming.
- Enhance problem-solving skills by using algorithms and logic in both languages.

Course Content:
The following are the primary focuses of this course:

Introduction to programming concepts, Overview of algorithms, data types, variables, and control structures, Basic Syntax, Writing and running simple programs, Introduction to the syntax and structure of C and Python, Data Types and Variables, integers, floating-point numbers, characters, Variable declaration, assignment, and naming conventions, Looping structures, Programming Fundamentals, Functions and Modular Programming, Creating functions in C and Python, return values, Arrays and Lists, Working with arrays in C, Lists in Python and their operations, String manipulation and handling in both C and Python, Introduction to Data Structures, Basic data structures such as stacks, queues, and linked lists, Introduction to Algorithms, Basic sorting and
searching algorithms, Introduction to Python Specifics, Python Specifics: Pythonic programming style and Python libraries and modules.

**Course Outcomes**

- Demonstrate skill in C and Python programming, including scripting, debugging, and execution.
- Use programming concepts to address real-world problems using appropriate algorithms and data structures.
- Explain the pros and cons of using C and Python for different programming tasks.

**Textbooks**


*******

**English for Communication Skills**

<table>
<thead>
<tr>
<th>HSMC-01</th>
<th>English for Communication Skills</th>
<th>2L:0T:2P</th>
<th>3 credits</th>
</tr>
</thead>
</table>

**Course Objectives**

- Improve grammar, vocabulary, and comprehension for better communication.
- Improve both written and oral English for various communication settings.
- Understand cultural differences and etiquette for effective English-speaking conversation.

**Course Content:**
The following are the primary focuses of this course:

Definition and importance of effective communication, Types of communication (verbal, non-verbal, written, and visual), speaking skills, learning skills, conversational skills, academic writing, business writing, presentation skills, digital communication (use of social media and email), resumes and cover letter writing.

**Course Outcomes**

- Learn and improve English grammar, vocabulary, and comprehension.
- Gain confidence in expressing ideas, opinions, and facts in English.

**Textbooks**


Communication Skills for Engineers and Scientists (2023) by Sangeeta Sharma and Binod Mishra, 2nd edition

********

Design Thinking

<table>
<thead>
<tr>
<th>HSMC-102</th>
<th>Design Thinking</th>
<th>0L:0T:2P</th>
<th>1 Credit</th>
</tr>
</thead>
</table>

Course Objectives

The objective of this Course is to provide the new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products which useful for a student in preparing for an engineering career.

Course Contents:

Unit 1: An Insight to Learning
Understanding the Learning Process, Kolb’s Learning Styles, Assessing and Interpreting

Unit 2: Remembering Memory
Understanding the Memory process, Problems in retention, Memory enhancement techniques

Unit 3: Emotions: Experience & Expression
Understanding Emotions: Experience & Expression, Assessing Empathy, Application with Peers

Unit 4: Basics of Design Thinking
Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test

Unit 5: Being Ingenious & Fixing Problem
Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving

Unit 6: Process of Product Design
Unit 7: Prototyping & Testing
What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing

Unit 8: Celebrating the Difference
Understanding Individual differences & Uniqueness, Group Discussion and Activities to encourage the understanding, acceptance and appreciation of Individual differences

Unit 9: Design Thinking & Customer Centricity
Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design

Unit 10: Feedback, Re-Design & Re-Create
Feedback loop, Focus on User Experience, Address “ergonomic challenges, User focused design, rapid prototyping & testing, final product, Final Presentation – “Solving Practical Engineering Problem through Innovative Product Design & Creative Solution”.

Text/Reference Books:
1. E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company.

Course Outcomes (CO):
Student will able to:

- Compare and classify the various learning styles and memory techniques and Apply them in their engineering education
- Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products
- Develop new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products
- Propose real-time innovative engineering product designs and Choose appropriate frameworks, strategies, techniques during prototype development
- Perceive individual differences and its impact on everyday decisions and further Create a better customer experience

*******
### Course Objectives:

1. To learn all the skills associated with the tools and inventory associated with the IDEA Lab.
2. Learn useful mechanical and electronic fabrication processes.
3. Learn necessary skills to build useful and standalone system/project with enclosures.
4. Learn necessary skills to create print and electronic documentation for the system/project.

### Course Contents:

<table>
<thead>
<tr>
<th>Unit #</th>
<th>Topics</th>
<th>Introduction to basic hand tools - Tape measure, combination square, Vernier caliper, hammers, fasteners, wrenches, pliers, saws, tube cutter, chisels, vice and clamps, tapping and threading. Adhesives.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Electronic component familiarization, Understanding electronic system design flow. Schematic design and PCB layout and Gerber creation using EagleCAD. Documentation using Doxygen, Google Docs, Overleaf. Version control tools - GIT and GitHub. Basic 2D and 3D designing using CAD tools such as FreeCAD, Sketchup, Prusa Slicer, FlatCAM, Inkspace, OpenBSP and VeriCUT.</td>
<td>Introduction to Power tools: Power saws, band saw, jigsaw, angle grinder, belt sander, bench grinder, rotary tools. Various types of drill bits,</td>
</tr>
<tr>
<td>2.</td>
<td>Familiarization and use of basic measurement instruments - DSO including various triggering modes, DSO probes, DMM, LCR bridge, Signal and function generator. Logic analyzer and MSO. Bench power supply (with 4-wire output) Circuit prototyping using (a) breadboard, (b) Zero PCB (c) ‘Manhattan’ style and (d) custom PCB. Single, double and multilayer PCBs. Single and double-sided PCB prototype fabrication in the lab. Soldering using soldering iron/station. Soldering using a temperature controlled reflow oven. Automated circuit assembly and soldering using pick and place machines.</td>
<td>Mechanical cutting processes - 3-axis CNC routing, basic turning, milling, drilling and grinding operations, Laser cutting, Laser engraving etc. Basic welding and brazing and other joining techniques for assembly. Concept of Lab aboard a Box.</td>
</tr>
</tbody>
</table>

3D printing and prototyping technology – 3D printing using FDM, SLS and SLA. Basics of 3D scanning, point cloud data generation for reverse engineering. Prototyping using subtractive cutting processes. 2D and 3D Structures for prototype building using Laser cutter and CNC routers. Basics of IPR and patents; Accessing and utilizing patent information in IDEA Lab

4. Discussion and implementation of a mini project.

5. Documentation of the mini project (Report and video).

### Laboratory Activities:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>List of Lab activities and experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.</td>
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<tr>
<td>2.</td>
<td>Machining of 3D geometry on soft material such as soft wood or modelling wax.</td>
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<tr>
<td>3.</td>
<td>3D scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer.</td>
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<tr>
<td>4.</td>
<td>2D profile cutting of press fit box/casing in acrylic (3 or 6 mm thickness)/cardboard, MDF (2 mm) board using laser cutter &amp; engraver.</td>
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<tr>
<td>5.</td>
<td>2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.</td>
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<tr>
<td>6.</td>
<td>Familiarity and use of welding equipment.</td>
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<tr>
<td>7.</td>
<td>Familiarity and use of normal and wood lathe.</td>
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<tr>
<td>8.</td>
<td>Embedded programming using Arduino and/or Raspberry Pi.</td>
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<tr>
<td>9.</td>
<td>Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.</td>
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</table>
### Reference Books:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title</th>
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SEMESTER – II
Mathematics-II

<table>
<thead>
<tr>
<th>BSC-04</th>
<th>Mathematics-II</th>
<th>3L:0T:0P</th>
<th>3 credits</th>
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</thead>
</table>

**Course Objectives:**

- Develop sophisticated mathematical skills beyond the basics, such as differential equations, linear algebra, and probability theory.
- Improve problem-solving ability by applying sophisticated mathematical principles.
- Allow students to apply sophisticated mathematical principles to engineering challenges and real-world circumstances.

**Course Contents:**

The following are the primary focuses of this course:

Infinite series, definition, and properties of Laplace transforms, solving linear differential equations using laplace transforms, Inverse Laplace transforms, numerical methods, Numerical solutions of nonlinear equations, numerical differentiation, and integration, Vector Calculus: Scalar and vector fields, level surfaces, directional derivative, Gradient, Curl, Divergence, Laplacian, line and surface integrals, theorems of Green, Gauss and Stokes, line integrals independent of path.

**Course Outcomes:**

- Exhibit mastery in probability theory, linear algebra, and differential equations.
- Aptitude for applying sophisticated mathematical ideas to tackle difficult situations.
- Effectively analyze and resolve engineering challenges by utilizing sophisticated mathematical concepts.

**Textbooks:**

- Higher Engineering Mathematics (2017) by Bandaru Ramana

Introduction to Management Science

<table>
<thead>
<tr>
<th>BSC-05</th>
<th>Introduction to Management Science</th>
<th>3L:0T:0P</th>
<th>3 credits</th>
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</table>

**Course Objectives:**

- Introduce basic management principles and theories, such as planning, organizing, and decision-making.
- Develop the analytical thinking and problem-solving skills essential for managerial decision-making.
• Understand the practical applicability of management principles in real-life settings and company environments.

Course Contents:

The following are the primary focuses of this course:

Basic and Advanced linear programming, Simplex Method, sensitivity analysis and its application in operations, supply chain, finance, and operation management, integer programming, network models and their application, non-linear optimization models, project scheduling (i.e., PERT/CPM), Inventory models, simulation modeling, decisions analysis, multi-criteria decision making, forecasting and Markov processes, dynamic programming

Course Outcomes:

• Understand, comprehend, and articulate basic theories and concepts in management.
• Gain the analytical abilities required for problem-solving and managerial decision-making.
• Effectively apply management concepts in a range of real-world contexts.

Textbooks


Environmental Studies

<table>
<thead>
<tr>
<th>HSMC-03</th>
<th>Environmental Studies</th>
<th>3L:0T:0P</th>
<th>3 credits</th>
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Course Objectives:

• Teach students about sustainability, ecology, and environmental issues.
• Acquire critical thinking abilities to assess environmental issues and possible fixes.
• Promote awareness of the value of sustainable lifestyles and practices.

Course Contents:

The following are the primary focuses of this course:

Introduction to environmental science, living organisms and their environment, understanding ecosystems and their components, biodiversity, its importance, earth atmosphere, climate weather, water pollution, climate change, population growth, earth's geological process, air pollution, biodiversity, greenhouse gas emissions, water cycle, resource depletion, population and environment, soil formation, population and environment, renewable and non-renewable sources of energy, Land use patterns, Land degradation, forest conservation, water scarcity, issues related to water quality, watershed management, water conservation, Endangered species, protected areas, and wildlife management, environmental issues, sustainable development, environment impact and
laws and policies for environment protection, awareness about the sustainability, capacity building for environment education.

Course Outcomes:

- Understand and explain various environmental problems and their implications.
- Analyze environmental issues critically and propose potential solutions.
- Apply principles of sustainability to promote environmentally friendly behaviors.

Textbooks

- Introduction to Environmental Engineering and Science (2015), 3e by Masters, Pearsons

Reference Books:


Basic Economics

<table>
<thead>
<tr>
<th>BSC-05</th>
<th>Basic Economics</th>
<th>3L:0T:0P</th>
<th>3 credits</th>
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</table>

Course Objectives:

- Incorporate essential economic principles, such as supply and demand, market structures, macroeconomic indicators, and more.
- Conduct an analysis of economic phenomena and decision-making processes by applying economic theories.
- Comprehend the applicability of economic principles across a wide range of business and societal contexts.

Course Contents:
The following are the primary focuses of this course:
Definition of economics, microeconomics, macroeconomics, various economic systems, understanding supply and demand, utility, and presence, costs of production and production functions, competitive market, competition, and pricing strategies, gross domestic product, inflation and deflation, monetary and fiscal policy, international trade, trade agreements, measurement of economic development and growth.

Course Outcomes:

- Comprehend and articulate fundamental economic principles along with their practical implementations.
- Analyse practical economic situations by applying economic theories.
Employ economic principles in order to comprehend and confront economic challenges that arise in various contexts.

Textbooks
- Sociology & Economics for Engineers by Premvir Kapoor, Khanna Publishing House.

********

Engineering Mechanics

| ES-03 | Engineering Mechanics | 2L:0T:2P | 3 credits |

Course Objectives:
- Include statics and dynamics in the demonstration of basic mechanical principles.
- Develop problem-solving skills by applying mechanics concepts to the study and resolution of engineering difficulties.
- Recognise the application of mechanics in the analysis and design of engineering structures.

Course Contents:
The following are the primary focuses of this course:

Basics of mechanics, units of measurement, centre of gravity, moment of inertia, vectors, and scalars, forces, frames and moment, equilibrium of particles, equilibrium of rigid particles, trusses, beams, friction, kinematics, kinetics, work, and energy, virtual work, momentum and impulse, circular motion, projectiles, harmonic motion, collision, mechanical vibrations.

Course Outcomes:
- Understand and describe the fundamental principles of statics and dynamics.
- Effectively address engineering challenges using mechanics concepts.
- Apply mechanics concepts to the analysis and design of engineering structures.

Textbooks

*******
**Electrical Engineering Fundamentals**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>L:T:P</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>ES-04</td>
<td>Electrical Engineering Fundamentals</td>
<td>2:0:2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- Cover fundamental electrical principles and circuits, such as Ohm's Law, circuits, and basic components.
- Offer hands-on experience with electrical circuits and components.
- Understand how electrical concepts are applied in diverse devices and systems.

**Course Contents:**
The following are the primary focuses of this course:

Basics of electrical concepts, voltage, and its source, current and power, ohm’s law, basic electrical circuit, Kirchhoff’s law for current and voltage, electrical machines, power systems, introduction to semiconductor, AC and DC current, AC circuit analysis, transformer, basics of logic circuit, Proportional-Integral-Derivative (PID) controllers, electromagnetic fields and waves, Maxwell’s equations, electronic devices, and amplifiers.

**Course Outcomes:**
- Comprehend the fundamental concepts and applications of electricity.
- Employ electrical principles to analyze and design fundamental circuits.
- Recognize the function of electrical principles in a variety of electronic systems and devices.

**Textbooks**
- Basic Electrical Engineering by Ritu Sahdev, Khanna Book Publishing Co.
- Basic Electrical and Electronics Engineering, (2017) 2/e by S.K. Bhattacharya

********

**Workshop Practice**

<table>
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<tr>
<th>Course</th>
<th>Title</th>
<th>L:T:P</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ES-05</td>
<td>Workshop Practice</td>
<td>0:1:2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- Offer hands-on experience operating workshop equipment, systems, and adhering to safety procedures.
- Acquire the fundamental ability to operate workshop materials and apparatus.
- Participate in workshop activities while comprehending and applying safety, precision, and accuracy protocols.

**Course Contents:**

The following are the primary focuses of this course:
Workshop safety, measurement tools, carpentry and woodworking, fitting, welding tools and joining techniques, sheet metal working, basic electrical work, metal cutting, turning, machining, milling, and drilling.

**Course Outcomes:**

- Exhibit proficiency in operating workshop equipment and apparatus.
- Acquire fundamental abilities to operate and manipulate workshop equipment.

**Textbooks**

- Workshop Practice (2013) by Swarn Singh
- Workshop Practice by H.S. Bawa

*****
SEMESTER – III
Introduction to Probability and Statistics

Course Objectives:
- Introduce fundamental concepts of probability theory and its applications.
- Develop skills in statistical analysis, including data collection, analysis, and interpretation.
- Understand how probability and statistics are applied in real-world scenarios for decision-making.

Course Contents:
The following are the primary focuses of this course:

Basic concepts of probability, Probability axioms and rules, Conditional probability, and independence. Discrete and continuous random variables, Probability mass functions (PMF) and probability density functions (PDF), Cumulative distribution functions (CDF), Expected value and variance of random variables. Binomial, Poisson, Normal distributions and Exponential distributions, Sampling Distributions and Central Limit Theorem, Point estimation, Confidence intervals, Hypothesis testing, Linear regression, Multiple regression and Model assessment and selection, and Analysis of variance (ANOVA).

Course Outcomes:
- Demonstrate a comprehensive understanding of probability theory.
- Apply statistical techniques to analyze and interpret data effectively.
- Apply probability and statistical methods to support decision-making processes.

Textbooks
- The Practice of Business Statistics by Manish Sharma & Amit Gupta, Khanna Publishing.
- Introduction to Probability and Statistics for Engineers and Scientists (2021), 5e by Sheldon M. Ross, Academic Press.
- Engineering Statistics (2000), 2e by Douglas C. Montgomery and George C. Runger

********
Operations Research-I

Course Objectives:
- Introduce mathematical methods for problem-solving and decision-making in operations.
- Teach optimization methods to improve efficiency and decision-making in operations.
- Understand the application of operations research techniques in real-life business scenarios.

Course Contents:
The following are the primary focuses of this course:
Overview of operations research, applications and their role in the decision-making process, Formulation of LP problems, Graphical solution method, Simplex method, Duality in LP, Introduction to integer programming, Branch, and bound method, Cutting plane methods, Formulation and solution methods for transportation problems, Assignment problems, Introduction to network models (e.g., shortest path, minimal spanning tree, maximum flow), Solution techniques for network models, Project scheduling: CPM, PERT, Project Crashing, Basics of dynamic programming, Applications in resource allocation and project scheduling, Introduction to queuing models, Characteristics of queuing systems, Basic queuing formulas, Inventory control models (e.g., EOQ - Economic Order Quantity), ABC analysis, Decision-making under uncertainty, Decision trees, Sensitivity analysis, Introduction to game theory, Two-person zero-sum games, Nash equilibrium, Basics of simulation modeling, Monte Carlo simulation, Introduction to optimization software tools (e.g., Excel Solver, LINGO/LINDO).

Course Outcomes:

- Apply mathematical methods to solve complex operational problems.
- Utilize optimization techniques to improve operational efficiency.
- Apply operations research techniques in analyzing and solving business problems.

Textbooks

- Operations Research: An Introduction, (2021) 10e by Hamdy A. Taha

**********

Managerial Accounting

| PCC-02 | Managerial Accounting | 3L:0T:0P | 3 credits |

Course Objectives:

- Introduce managerial accounting concepts, including cost analysis and budgeting.
- Provide tools and techniques for managerial decision-making using accounting information.
- Understand how managerial accounting aids in planning, control, and decision-making.

Course Contents:

The following are the primary focuses of this course:

Introduction to managerial accounting, Types of costs (e.g., variable, fixed, mixed), Contribution margin analysis, Breakeven analysis, Profit planning and budgeting, Cost behavior, Cost concepts and classifications, Cost behavior and cost-volume-profit analysis, Process costing systems, Activity-based costing, traditional costing, Job order costing, Budgeting and performance measurement, Variance analysis (e.g., flexible budgets, standard costing) Capital investment
decision methods, Cost control techniques, Financial statement analysis, Management control systems, Transfer Pricing, International Accounting.

Course Outcomes:

- Understand and apply managerial accounting concepts in business contexts.
- Use accounting information to support managerial decision-making.
- Apply managerial accounting techniques for planning and control in business management.

Textbooks

- Managerial Accounting (2023), 16th Edition by Kurt Heisinger and Joe Hoyle

Textbooks

<table>
<thead>
<tr>
<th>PCC-03</th>
<th>Data Analytics for Managerial Decisions</th>
<th>3L:0T:0P</th>
<th>3 credits</th>
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</thead>
</table>

Course Objectives:

- Develop skills in analyzing and interpreting data for managerial decision-making.
- Introduce techniques for predictive analytics to forecast trends and patterns.
- Understand how data analytics aids in strategic decision-making processes.

Course Contents:

The following are the primary focuses of this course:

Overview of data analytics, Data sources, and types, Data collection methods, Data cleaning and preprocessing, Data summarization techniques, Data visualization tools, and concepts, Exploratory data analysis (EDA), Predictive Analytics (Regression analysis for forecasting, Time series analysis and Machine learning for prediction), Optimization models and techniques, Decision trees and decision analysis, Simulation modeling, Principles of effective data visualization, Tools for creating data visualizations, Introduction to big data and data mining, and Techniques for analyzing large datasets. Analyzing text data for insights, Sentiment analysis of customer feedback and social media data, Building interactive dashboards for reporting and monitoring, and Business intelligence platforms and tools.

Course Outcomes:

- Analyze and interpret data effectively for managerial decisions.
- Apply predictive analytics techniques to forecast trends and patterns.

Textbooks

Introduction to logistics and supply chain management

<table>
<thead>
<tr>
<th>PCC-04</th>
<th>Introduction to logistics and supply chain management</th>
<th>3L:0T:0P</th>
<th>3 credits</th>
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</thead>
</table>

Course Objectives:
- Introduce the basics of logistics and supply chain management.
- Understand how logistics and supply chain processes optimize business operations.
- Learn to manage the flow of goods and information in supply chain networks efficiently.

Course Contents:
The following are the primary focuses of this course:

The importance of logistics and supply chain management in engineering, demand management in the supply chain, inventory control models, warehousing and inventory management, forecasting, information technology in logistics and supply chain management, supplier collaboration, supplier selection, network design and planning in the supply chain, sustainable supply chain, distribution strategies in the supply chain, supply chain contracts, supply chain risk management, strategic sourcing, reverse logistics, transportation modes, and management.

Course Outcomes:
- Understand the fundamentals of logistics and supply chain management principles.
- Apply logistics and supply chain strategies to optimize business operations.
- Manage the flow of goods and information effectively within supply chain networks.

Textbooks
Course Objectives:

- Introduce the concepts and initiatives in the 'Naya Bharat' (New India) context.
- Explore the role of logistics in national development and economic growth.
- Understand sustainable logistics practices and innovative solutions for Naya Bharat.

Course Contents:
The following are the primary focuses of this course:

A review of India’s economic transformation and the “New India” vision lean and just-in-time (JIT) and lean concepts in Indian manufacturing, Logistics and the management of food supply chains, Last-mile delivery and omnichannel logistics, Logistics for pharmaceuticals and medical devices The significance of logistics facilities and nodes, PM Gati Shakti-Master National Plan, Government policies and initiatives promoting logistics and supply chain productivity, environmental and social responsibility practices in logistics, Logistics innovations fuelled by digitalization and technology like blockchain, case studies pertaining to National Logistics policy and PM Gati Shakti-Master National Plan.

Course Outcomes:

- Understand and explain the initiatives and concepts related to 'Naya Bharat'.
- Analyze the role of logistics in the development of the nation's economy.
- Propose sustainable logistics practices and innovative solutions for the development of 'Naya Bharat'.

Textbook


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Universal Human Values-II: Understanding Harmony and Ethical Human Conduct

Pre-requisites: None. Universal Human Values 1 (Desirable)

1-COURSES ON HUMAN VALUES

During the Induction Program, students would get an initial exposure to human values through Universal Human Values-I. This exposure is to be augmented by this compulsory full semester foundation course.

Objectives of UHV-II Course

This introductory course input is intended:
1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.

2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Thus, this course is intended to provide a much-needed orientational input in value education to the young enquiring minds.

**Salient Features of the Course**

The salient features of this course are:

1. It presents a universal approach to value education by developing the right understanding of reality (i.e. a worldview of the reality “as it is”) through the process of self-exploration.

2. The whole course is presented in the form of a dialogue whereby a set of proposals about various aspects of the reality are presented and the students are encouraged to self-explore the proposals by verifying them on the basis of their natural acceptance within oneself and validate experientially in living.

3. The prime focus throughout the course is toward affecting a qualitative transformation in the life of the student rather than just a transfer of information.

4. While introducing the holistic worldview and its implications, a critical appraisal of the prevailing notions is also made to enable the students discern the difference on their own right.

**Course Methodology**

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.

2. The course is in the form of 28 lectures (discussions) and 14 practice sessions.

3. It is free from any dogma or value prescriptions.

4. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation – the whole existence is the lab and every activity is a source of reflection.

5. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous self-evolution.

6. This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.
2-COURSE TOPICS

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 01-hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.

The Teacher’s Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

The syllabus for the lectures and practice sessions is given below:

Module 1 – Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session PS1 Sharing about Oneself
Lecture 3: Self-exploration as the Process for Value Education
Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

Expected outcome:

The students start exploring themselves: get comfortable with each other and with the teacher; they start appreciating the need and relevance for the course.

The students start finding that technical education without study of human values can generate more problems than solutions. They also start feeling that lack of understanding of human values is the root cause of most of the present-day problems; and a sustained solution could emerge only through understanding of value-based living. Any solution brought out through fear, temptation of dogma will not be sustainable.

The students are able to see that verification on the basic of natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with authenticity; it will only develop assumptions.

The students are able to see that their practice in living is not in harmony with their natural acceptance most of the time, and all they need to do is to refer to their natural acceptance to overcome this disharmony.
The students are able to see that lack of right understanding leading to lack of relationship is the major cause of problems in their family and not the lack of physical facility in most of the cases, while they have given higher priority to earning of physical facility in their life giving less value to or even ignoring relationships and not being aware that right understanding is the most important requirement for any human being.

**Module 2 – Harmony in the Human Being (6 lectures and 3 tutorials for practice session)**

- **Lecture 7**: Understanding Human being as the Co-existence of the Self and the Body
- **Lecture 8**: Distinguishing between the Needs of the Self and the Body
- **Tutorial 4: Practice Session PS4**  Exploring the difference of Needs of Self and Body
- **Lecture 9**: The Body as an Instrument of the Self
- **Lecture 10**: Understanding Harmony in the Self
- **Tutorial 5: Practice Session PS5**  Exploring Sources of Imagination in the Self
- **Lecture 11**: Harmony of the Self with the Body
- **Lecture 12**: Programme to ensure self-regulation and Health
- **Tutorial 6: Practice Session PS6**  Exploring Harmony of Self with the Body

**Expected outcome:**

The students are able to see that they can enlist their desires and the desires are not vague. Also they are able to relate their desires to ‘I’ and ‘Body’ distinctly. If any desire appears related to both, they are able to see that the feeling is related to I while the physical facility is related to the body. They are also able to see that ‘I’ and Body are two realities, and most of their desires are related to ‘I’ and not body, while their efforts are mostly centered on the fulfilment of the needs of the body assuming that it will meet the needs of ‘I’ too.

The students are able to see that all physical facility they are required for a limited time in a limited quantity. Also, they are able to see that in case of feelings, they want continuity of the naturally acceptable feelings and they do not want feelings which are not naturally acceptable even for a single moment.

The students are able to see that activities like understanding, desire, though and selection are the activities of ‘I’ only the activities like breathing, palpitation of different parts of the body are fully the activities of the body with the acceptance of ‘I’ while the activities they do with their sense organs like hearing through ears, seeing through eyes, sensing through touch, tasting through tongue and smelling through nose or the activities they do with their work organs like hands, legs etc. are such activities that require the participation of both ‘I’ and body.

The students become aware of their activities of ‘I’ and start finding their focus of attention at different moments. Also they are able to see that most of their desires are coming from outside (through preconditioning or sensation) and are not based on their natural acceptance

The students are able to list down activities related to proper upkeep of the body and practice them in their daily routine. They are also able to appreciate the plants wildly growing in and around the campus which can be beneficial in curing different diseases.
Module 3 – Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

Expected outcome:

The students are able to note that the natural acceptance (intention) is always for living in harmony, only competence is lacking! We generally evaluate ourselves on the basis of our intention and others on the basis of their competence! We seldom look at our competence and others’ intention as a result we conclude that I am a good person and other is a bad person.

The students are able to see that respect is right evaluation, and only right evaluation leads to fulfilment in relationship. Many present problems in the society are an outcome of differentiation (lack of understanding of respect), like gender biasness, generation gap, caste conflicts, class struggle, dominations through power play, communal violence, clash of isms and so on so forth. All these problems can be solved by realizing that the other is like me as he has the same natural acceptance, potential and program to ensure a happy and prosperous life for them and for others through he may have different body, physical facility or beliefs.

The students are able to use their creativity for education children. The students are able to see that they can play a role in providing value education for children. They are able to put in simple words the issues that are essential to understand for children and comprehensible to them. The students are able to develop an outline of holistic model for social science and compare it with the existing model.

Module 4 – Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)

Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence

Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence

Expected outcome:

The students are able to differentiate between the characteristics and activities of different orders and study the mutual fulfilment among them. They are also able to see that human beings are not fulfilling to other orders today and need to take appropriate steps to ensure right participation (in terms of nurturing, protection and right utilization) in the nature.

The students feel confident that they can understand the whole existence; nothing is a mystery in this existence. They are also able to see the interconnectedness in the nature, and point out how different courses of study relate to the different units and levels. Also, they are able to make out how these courses can be made appropriate and holistic.

Module 5 – Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)

Lecture 23: Natural Acceptance of Human Values

Lecture 24: Definitiveness of (Ethical) Human Conduct

Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct

Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order

Lecture 26: Competence in Professional Ethics

Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education

Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies

Lecture 28: Strategies for Transition towards Value-based Life and Profession

Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Expected outcome:

The students are able to present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.

The students are able to grasp the right utilization of their knowledge in their streams of Technology/Engineering/Management/any other area of study to ensure mutual fulfilment. E.g. mutually enriching production system with rest of nature.

The students are able to sincerely evaluate the course and share with their friends. They are also able to suggest measures to make the course more effective and relevant. They are also able to make use of their understanding in the course for the happy and prosperous family and society.
Guidelines and Content for Practice Sessions (Tutorials)

In order to connect the content of the proposals with practice (living), 14 practice sessions have been designed. The full set of practice sessions is available in the Teacher’s Manual as well as the website.

Practice Sessions for Module 1 – Introduction to Value Education
PS1 Sharing about Oneself
PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance

Practice Sessions for Module 2 – Harmony in the Human Being
PS4 Exploring the difference of Needs of Self and Body
PS5 Exploring Sources of Imagination in the Self
PS6 Exploring Harmony of Self with the Body

Practice Sessions for Module 3 – Harmony in the Family and Society
PS7 Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for Module 4 – Harmony in the Nature (Existence)
PS10 Exploring the Four Orders of Nature
PS11 Exploring Co-existence in Existence

Practice Sessions for Module 5 – Implications of the Holistic Understanding – a Look at Professional Ethics
PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

As an example, PS7 is a practice session in module 3 regarding trust. It is explained below:

PS7: Form small groups in the class and in that group initiate dialogue and ask the eight questions related to trust. The eight questions are:
1a. Do I want to make myself happy?  
1b. Am I able to make myself always happy?  
2a. Do I want to make the other happy?  
2b. Am I able to make the other always happy?  
3a. Does the other want to make him happy?  
3b. Is the other able to make him always happy?  
4a. Does the other want to make me happy?  
4b. Is the other able to make me always happy?  

Intention (Natural Acceptance)  
What is the answer?  

Competence  
What is the answer?  

Let each student answer the questions for himself/herself and everyone else. Discuss the difference between intention and competence. Observe whether you evaluate your intention and competence as well as the others’ intention and competence.

**Expected outcome of PS7:** The students are able to see that the first four questions are related to our Natural Acceptance i.e. intention and the next four to our Competence. They are able to note that the intention is always correct, only competence is lacking! We generally evaluate ourselves on the basis of our intention and others on the basis of their competence! We seldom look at our competence and others’ intention, as a result we conclude that I am a good person and other is a bad person.

**3-READINGS:**

**3-1-Text Book and Teachers Manual**

a. The Textbook


b. The Teacher’s Manual


**3-2-Reference Books**

3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

4-MODE OF CONDUCT (L-T-P-C 2-1-0-3)

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor’s role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one’s own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up “ordinary” situations rather than “extra-ordinary” situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department.

Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

5-SUGGESTED ASSESSMENT:
This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

**Example:**

Assessment by faculty mentor: 10 marks
Self-assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks
Semester End Examination: 50 marks

The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

**6-OUTCOME OF THE COURSE:**

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

Therefore, the course and further follow up is expected to positively impact common graduate attributes like:

1. Holistic vision of life
2. Socially responsible behaviour
3. Environmentally responsible work
4. Ethical human conduct
5. Having Competence and Capabilities for Maintaining Health and Hygiene
6. Appreciation and aspiration for excellence (merit) and gratitude for all

This is only an introductory foundational input. It would be desirable to follow it up by
a) Faculty-student or mentor-mentee programs throughout their time with the institution
b) Higher level courses on human values in every aspect of living.

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SEMESTER – IV
AICTE Model Curriculum for UG Degree Course in Logistics and Supply Chain Management

Operations Research-II

| PCC-06 | Operations Research-II | 3L:0T:0P | 3 credits |

Course Objectives:

- Provide advanced mathematical models and approaches for dealing with complicated operational challenges.
- Develop optimization strategies for resource allocation and operational decision-making.
- Recognise how operations research approaches can be applied to real-world operational difficulties.

Course Contents:
The following are the primary focuses of this course:

Unconstrained optimization, Constrained optimization and KKT conditions, Algorithms for solving nonlinear programming problems, Formulation of integer programming problems, Branch-and-bound and branch-and-cut algorithms, Applications in combinatorial optimization, Introduction to dynamic programming, and its Applications, Overview of heuristic and metaheuristic algorithms (e.g., genetic algorithms, simulated annealing), Solving complex optimization problems using heuristics, Pareto optimality and multi-objective decision-making, Algorithms for solving multi-objective optimization problems.

Course Outcomes:

- Solve complex operational challenges using powerful mathematical models.
- Use optimization strategies to allocate resources more efficiently.
- Use operations research methods to analyze and solve difficult operational problems.

Textbooks


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**Introduction to Multimodal logistics**

| PCC-07 | Introduction to Multimodal logistics | 3L:0T:0P | 3 credits |

**Course Objectives:**
- Introduce the logistics ideas and practices of utilizing numerous modes of transportation.
- Discover techniques for increasing efficiency and integration in multimodal logistics operations.
- Recognize risk factors and management techniques related to multimodal logistics.

**Course Contents:**
The following are the primary focuses of this course:

Modes of transportation, Road transportation (Trucks, carriers, and infrastructure), Rail transportation (Freight trains, intermodal, and rail yards), Air transportation (Cargo airlines, airports, airfreight logistics), Maritime transportation (shipping lines, ports, and containerization), Intermodal transportation, multi-modal transportation systems, the role of Multi-modal logistics for world economic corridors, government policies, and regulations for multi-modal logistics, Container Freight Station (CFS) Terminals, Roll-on/Roll-Off Service, Development of multi modal transport system in India - Metro Rails, Light Rail Transit (LRT), Sub-Urban Trains, Ring Rail and Monorails, Bus Rapid Transit Systems, Bullet Trains. City Transport. Inland Waterways, Economic corridors, Containerization, Non-containerization cargo, dry ports, pipelines, palletization, Channel tunnel.

Technologies for transportation systems, the role of transportation mode in first-mile, last-mile delivery, and hyper-local delivery, simulation, and modeling in logistics, Warehouse management systems (WMS), route optimization, documentation, and regulatory framework for domestic and international freight, strategies for sustainable and efficient multi-modal logistics.

**Course Outcomes:**
- Understand and define the principles governing the utilization of various forms of transportation in logistics.
- Implement approaches to increase efficiency and integration in multimodal logistics operations.

**Textbooks**
- Global Supply Chains and Multimodal Logistics: Emerging Research and Opportunities (Advances in Logistics, Operations, and Management Science (ALOMS)) by Deepankar Sinha
- Handbook of Logistics, Shipping, and Commercial Terminologies (2019) by Benny John

*****
Material Handling and Packaging

| PCC-08 | Material Handling and Packaging | 3L:0T:0P | 3 credits |

Course Objectives:
- Introduce the fundamentals and techniques of logistics material handling efficiency.
- Learn about techniques for optimising packing procedures in order to streamline logistical operations.

Course Contents:
The following are the primary focuses of this course:

Overview and importance of material handling equipment (Automated Electrified Monorail, conveyors, forklifts, cranes, AGVs, etc.) in logistics, automated storage systems, mechanisms of material handling, design principles of material handling, equipment, and workflow design, material storage, and retrieval design, digital technologies for material management for effective storage, performance material Safety measures, and regulations. Packaging overview, Types of packaging materials, benefits of effective packaging, Intelligent packaging, and IoT integration, sustainability practices in packaging, 3D printing in the design of packaging, Compostable and biodegradable packaging, strategies for environmentally friendly packaging, regulations for packaging, Case studies of innovative packaging.

Course Outcomes:
- Establish proficiency in logistics material handling techniques.
- Use packaging optimization solutions for more efficient logistics operations.
- Implement safety procedures to ensure efficient and safe material handling and packing.

Textbooks
- James Apple, Material Handling System Design, John Wiley
- Theodore H., Allegre Sr., Material Handling Principles and Practice, CBS Publishers, and Distributors

Financial management for supply chain leaders

| PCC-09 | Financial management for supply chain leaders | 3L:0T:0P | 3 credits |

Course Objectives:
- Introduce financial basics and supply chain management analytical techniques.
- Develop strategies for effectively managing costs in supply chain operations.

Course Contents:
The following are the primary focuses of this course:
The function of finance in supply chain leadership, understanding financial statements, supply chain costing and budgeting, capital budgeting and investment decisions in supply chain, key financial metrics for supply chain performance, supply chain financing alternatives, and ethical implications in supply chain finance.

**Course Outcomes:**

- Examine and manage supply chain finances by employing financial analysis methodologies.
- Use financial insights to make strategic decisions in supply chain operations.

**Textbooks**

- Financial Management: Theory & Practice by Eugene F. Brigham and Michael C. Ehrhardt
- Supply Chain Finance: A New Perspective on Cash Flow by Wendy Tate and Charles C. Thomas

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**Global Logistics and Supply Chain Management**

<table>
<thead>
<tr>
<th>PCC-10</th>
<th>Global Logistics and Supply Chain Management</th>
<th>3L:0T:0P</th>
<th>3 credits</th>
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**Course Objectives:**

- Introduce global logistics concepts and supply chain management concerns.
- Investigate the regulatory systems that influence global logistics.

**Course Contents:**

The following are the primary focuses of this course:

Introduction to Logistics in global context, International trade and logistics, Logistics System Design, Logistics Channels, Concept of Inventory related to logistics, Transit inventory, Warehousing, Warehousing decision models, Transportation models, Volume flow, India’s logistics transportation Sector and its challenges, Total logistics costs, Logistics metrics, Order Management, logistics information systems, Integration of all activities for effective supply chain performance, Risk management in global logistics, Customs regulations and documentation, Incoterms, and international shipping terms. Introduction to global Supply Chain Management, global network supply chain design, Strategic Importance of IT and computer Simulation in Supply Chain Management; Supply Chain Performance; Supply Chain System Slacks; Demand Management; Supply Management; Inventory Management; and Production Management.

**Course Outcomes:**

- Understand global logistics concepts and supply chain management difficulties.
- Implement international logistics and operations strategies that are efficient.

**Textbooks**

• Logistics & Supply Chain Management, (Latest edition), Martin Christopher, Prentice Hall.

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Introduction to AI and Machine Learning

| PCC-11 | Introduction to AI and Machine Learning | 3L:0T:0P | 3 credits |

Course Objectives:
• Introduce fundamental AI and machine learning concepts and applications in logistics.
• Investigate the use of AI and machine learning technologies to optimize logistical operations.

Course Contents:
The following are the primary focuses of this course:
Overview of AI and ML, Types of machine learning: supervised, unsupervised, reinforcement learning, Logistic regression, Linear regression, Decision trees and random forests, Linear Discriminant Analysis, Clustering algorithms (K-means, hierarchical clustering), Dimensionality reduction techniques (PCA) and Anomaly detection, Introduction to neural networks, Feedforward neural networks, Convolutional neural networks (CNNs), Recurrent neural networks (RNNs), Introduction to NLP, Sentiment analysis, text classification and ethics issues of artificial intelligence.

Course Outcomes:
• Describe the underlying concepts and uses of artificial intelligence and machine learning in logistics.
• Use artificial intelligence and machine learning to optimize logistics operations.
• Use AI and machine learning in logistics and supply chain management to do predictive analytics.

Textbooks
### Course Objectives:

- Investigate the various cultural, philosophical, and scientific dimensions of traditional Indian knowledge systems.
- Develop critical thinking abilities to assess the relevance and applicability of ancient Indian knowledge in modern circumstances.

### Course Contents:

The following are the primary focuses of this course:

Indian Knowledge System – An Introduction, The Vedic Corpus, Number System and Units of Measurements, Mathematics, Astronomy, Engineering and Technology: Metals and Metalworking, Engineering and Technology: Other Applications, Town Planning and Architecture, Knowledge Framework and Classification, Linguistics.

### Course Outcomes:

- Develop an understanding for India’s rich cultural legacy through its ancient knowledge systems.
- Practise critically analyzing and interpreting ancient writings, ideologies, and scientific ideas.

### Textbooks

- Pride of India: A Glimpse into India’s Scientific Heritage, Samskrita Bharati, New Delhi.
SEMESTER – V
Supply Chain Risk Modeling

| PCC-12 | Supply Chain Risk Modeling | 3L:0T:0P | 3 credits |

**Course Objectives:**

- Develop and implement strategies for identifying and evaluating risks in the operations of supply chain chains.
- Develop models that can quantify and analyze the many different hazards that are present within supply chain networks.

**Course Contents:**

Nature of Supply Chain Risks, Risk drivers (external and internal), Risk prediction and metrics, Concept of risk pooling, Formulating risk mitigation strategies, Risk mitigation plan rollout and control.

**Course Outcomes:**

- Implement comprehensive risk assessment in supply chain activities.
- Quantify and analyze supply chain risks using models.
- Implement effective supply chain risk mitigation techniques.

**Textbooks**


Logistics Network Design and Optimization

| PCC-13 | Logistics Network Design and Optimization | 3L:0T:0P | 3 credits |

**Course Objectives:**

- Introduce principles for creating effective logistics networks.
- Create methods to improve logistics network efficiency and cost-effectiveness.
- Learn how technology integration improves logistics network design and optimization.

**Course Contents:**

The following are the primary focuses of this course:
Requirements assessment - Location and capacity requirement analysis, Infrastructure analysis, Logistics network cost analysis, Owning vs outsourcing, Service level optimization, and Roadmap for logistics network design.
Course Outcomes:
- Develop optimal logistics networks utilizing acquired principles of efficiency.
- Develop and execute strategies to enhance the efficiency and effectiveness of logistics network operations.

Textbooks

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Port Terminal Management

<table>
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<th>PCC-14</th>
<th>Port Terminal Management</th>
<th>3L:0T:0P</th>
<th>3 credits</th>
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</thead>
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Course Objectives:
- Describe the concepts and procedures for effective port terminal management.
- Formulate plans to maximize throughput and efficiency in terminal operations.

Course Contents:
The following are the primary focuses of this course:

Introduction to ports, port functions, ships, cargo and terminals, port planning and equipment, port pricing, port competition, and legal aspects in ports and terminals.

Course Outcomes:
- Apply strategies for effective terminal operations into practise.
- Assure port terminal management of safety precautions and legal compliance.

Textbooks
- Saieva, G. Port Management and Operations (Lloyd's Practical Shipping Guides). Routledge

*******
Air cargo management

| PCC-15 | Air cargo management | 3L:0T:0P | 3 credits |

**Course Objectives:**
- Describe the fundamentals and procedures of air freight operations and logistics.
- Develop plans to streamline air freight operations for promptness and efficiency.
- Recognise and make sure that the rules governing air freight handling are followed.

**Course Contents:**
The following are the primary focuses of this course:

Air cargo industry and its stakeholders, Pricing, forecasting, railway operations and Road transportation/ trucking, load optimization, Regulatory framework, competition, and air cargo Operations Management.

**Course Outcomes:**
- Effectively manage air cargo logistics
- Assure adherence to rules regarding the handling of flying cargo.

**Textbooks**

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Innovation and Entrepreneurship

| PCC-16 | Innovation and Entrepreneurship | 3L:0T:0P | 3 credits |

**Course Objectives:**
- Gain knowledge about the procedures and methods used in the logistics and supply chain sector for innovation.
- Develop the skills required for supply chain and logistics-related entrepreneurial endeavours.
- Gain an understanding of and experience creating sustainable supply chain and logistics business concepts.

**Course Contents:**
The following are the primary focuses of this course:
Definition of innovation, Types of Innovations, startup ecosystem, Intellectual Property Rights (IPR) and patents, Govt. Schemes and funding support ideas, innovations, startups, startup methodology, funding, crowdfunding and alternative financial methods, Entrepreneurial opportunities, attitudes, traits, and tendencies. Types of entrepreneurship, Current trends, government policies for building entrepreneurship ecosystem.

Course Outcomes:

- Utilize innovative approaches and strategies in the domains of logistics and supply chain management.
- Acquire the requisite competencies for engaging in entrepreneurial endeavours within the industry.

Textbooks

- E. Balaguruswamy, Developing Thinking Skills, Khanna Book Publishing, 2022
- The Art of Innovation, by Tom Kelley, Crown Business

Simulation and digital twin lab

| PCC-17 | Simulation and digital twin lab | 0L:0T:6P | 3 credits |

Course Objectives:

- Explain simulation principles and how they apply to logistics and supply chain management.
- Investigate and comprehend the idea and application of digital twin technology in logistics.
- Provide hands-on experience using simulation and digital twin technology.

Course Contents:

The following are the primary focuses of this lab:

Introduction to simulation and digital twin concepts, agent-based simulation, Monte Carlo simulation, digital twin modeling, and analysis using anyLogistix, system dynamics modeling using STELLA, and simulation modeling using Arena, Any Logic.
Course Outcomes:
- Use simulation principles to model logistics and supply chain scenarios.
- Make efficient use of digital twin technology in logistics and supply chain management.
- Gain hands-on experience with simulation and digital twin technology applications.

Textbooks
- Simulation modeling and analysis (SIE) (2007) by Averill Law, Kelton, W. D., & Kelton, W. D.

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Indian Constitution

<table>
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<tr>
<th>Course Code</th>
<th>AU301</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Indian Constitution</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>0 (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Course Category</td>
<td>AU</td>
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</table>

Course Objective: - The course is designed to impart knowledge to understand the emergence and evolution of Indian Constitution and to understand and analyse the three organs of the state in the contemporary scenario.

Course Content

Module I: The Constitution - Introduction
- The History of the Making of the Indian Constitution
- Preamble and the Basic Structure, and its interpretation
- Fundamental Rights and Duties and their interpretation
- State Policy Principles

Module II – Union Government
- Structure of the Indian Union
- President – Role and Power
- Prime Minister and Council of Ministers
- Lok Sabha and Rajya Sabha

Module III – State Government
- Governor – Role and Power
- Chief Minister and Council of Ministers
- State Secretariat

Module IV – Local Administration
- District Administration
- Municipal Corporation
- Zila Panchayat

Module V – Election Commission
a. Role and Functioning
b. Chief Election Commissioner  
c. State Election Commission  

Text Books/Suggested Learning Resources:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>The Constitution of India</td>
<td>B.L. Fadia</td>
<td>Sahitya Bhawan; New edition (2017)</td>
</tr>
<tr>
<td>3</td>
<td>Introduction to the Constitution of India</td>
<td>DD Basu</td>
<td>Lexis Nexis; Twenty-Third 2018 edition</td>
</tr>
</tbody>
</table>

Suggested Software/Learning Websites:
1. [https://www.constitution.org/cons/india/const.html](https://www.constitution.org/cons/india/const.html)  
3. [https://www.sci.gov.in/constitution](https://www.sci.gov.in/constitution)  

Alternative NPTEL/SWAYAM Course:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>NPTEL ID</th>
<th>NPTEL Course Name</th>
<th>Instructor</th>
<th>Host Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12910600</td>
<td>Constitution Of India And Environmental Governance: Administrative And Adjudicatory Process</td>
<td>Prof. Sairam bhat, prof. M. K. Ramesh</td>
<td>National Law School Of India University</td>
</tr>
</tbody>
</table>

Course Outcomes: Upon completion of this course, the students will be able:
1. To Understand the emergence and evolution of Indian Constitution.  
2. To Understand the structure and composition of Indian Constitution  
3. To Understand and analyze federalism in the Indian context.  
4. To Analyze Panchayati Raj institutions as a medium of decentralization  
5. To Understand and Evaluate the Indian Political scenario amidst the emerging challenges.

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SEMESTER – VI
AICTE Model Curriculum for UG Degree Course in Logistics and Supply Chain Management
Maritime logistics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>PCC-18</td>
<td>Maritime logistics</td>
<td>3 credits</td>
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</table>

Course Objectives:
- Provide an overview of maritime logistics concepts and procedures, such as port operations and vessel management.
- Acquire knowledge of tactics to maximize supply chain flow via maritime transportation.

Course Contents:
The following are the primary focuses of this course:

Importance of maritime logistics in global trade, the structure of the maritime industry: vessel types, shipping lines, policies, and regulatory mechanism, types of port terminal operations, and the role of Industry 4.0 technologies in maritime logistics, demand, and inventory management in maritime logistics, modeling risk disruption, and resilience in maritime industry, sustainability issues in maritime logistics.

Course Outcomes:
- Effectively manage maritime logistics by applying acquired principles.
- Put plans in place for effective supply chain movement through maritime transportation.

Textbooks

Blockchains and smart contracts for Digital Supply Chains

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>PCC-19</td>
<td>Blockchains and smart contracts for Digital Supply Chains</td>
<td>3 credits</td>
</tr>
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</table>

Course Objectives:
- Give an overview of blockchain technology and how it can be used in digital supply chain management.
- Examine how supply chain transaction automation is facilitated by smart contracts.
- Gain an understanding of blockchain technology and smart contracts and use them to improve supply chain operations' efficiency and transparency.

Course Contents:
The following are the primary focuses of this course:

Significance of blockchain in digital supply chain, the basics of blockchain, the definition of smart contract, cybersecurity issues in blockchain for supply chain, the application of blockchain in the
supply chain, and sustainability aspects in blockchain. Introduction to Smart Contracts, Ethereum and Solidity, Components of Smart Contracts, Smart Contract Security, Smart Contract Deployment, Legal and Regulatory Considerations, Smart Contract Development Tools, Future Trends: Emerging technologies and trends in smart contracts (e.g., non-fungible tokens, DeFi, DAOs), Integration with IoT and AI.

**Course Outcomes:**

- Describe the fundamentals of blockchain technology and how digital supply chain management uses them.
- Use smart contracts to make supply chain transactions more automated and efficient.
- Utilise smart contracts and blockchain technology to increase supply chain operations’ efficiency and transparency.

**Textbook**
- Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications (2020) by Lorne Lantz, Daniel Cawry

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**Procurement and Supplier Relationship Management**

<table>
<thead>
<tr>
<th>PCC-20</th>
<th>Procurement and Supplier Relationship Management</th>
<th>3L:0T:0P</th>
<th>3 credits</th>
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</table>

**Course Objectives:**

- Introduce the fundamentals and operational procedures of procurement as they pertain to supply chain management.
- Formulate supplier relationship management strategies that are efficient.

**Course Contents:**

The following are the primary focuses of this course:

Introduction to procurement, purchasing policy and procedure, quality management, supplier selection, and evaluation, Principles of Contract Negotiation, contract management, cost management, purchasing ethics and laws, supplier relationship management framework, and procurement risk, supplier/vendor selection using Digital service provider/ consultant selection, including technical qualification

**Course Outcomes:**

- Establish and maintain effective connections with suppliers to ensure seamless operations.
- Ensure cost-effective purchase without sacrificing quality.

**Textbooks**

- Purchasing and Supply Chain Management (2020), by Robert Handfield, Larry Giunipero, James Patterson, Robert Monczka

******
### Warehouse and Distribution Management

<table>
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<tr>
<th>PCC-21</th>
<th>Warehouse and Distribution Management</th>
<th>3L:0T:0P</th>
<th>3 credits</th>
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</thead>
</table>

**Course Objective:**

- Introduce warehouse management principles and practices to the supply chain.
- Understand the basics of warehouse design, layout, and inventory control to get the most out of your business.

**Course Contents:**

Warehouse layout and design principles, space utilization and storage systems, Automation and technology in warehouse design and warehouse operations, warehouse management systems, recent trends in warehouse and distribution management.

**Outcome:**

- Demonstrate the skill to plan and oversee warehouse layouts that make storage, retrieval, and delivery as efficient as possible.
- Develop and execute plans to streamline distribution operations across the supply chain.

**Textbook**


### Enterprise Lab

<table>
<thead>
<tr>
<th>PCC-22</th>
<th>Enterprise Lab</th>
<th>0L:0T:6P</th>
<th>3 credits</th>
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</thead>
</table>

**Course Objectives:**

- Provide hands-on experience in implementing principles related to supply chain management in a commercial setting, whether it be a simulated or actual one.

**Course Contents:**

The following are the primary focuses of this lab:

Real-world challenges in logistics, e-commerce, port management, inventory control, supply chain disruptions, and demand planning. It leverages mathematical and AI models, along with industry-standard software tools like CPLEX/GUROBI. Generative AI and deep learning techniques will be applied to problem-solving, with a focus on creating informative dashboards. Students will gain hands-on experience by tackling practical issues faced by startup owners, MSME (Micro, Small, and Medium-sized Enterprises) owners, and well-documented case studies, using operations research (OR), AI, simulation, and various modeling tools such as anyLogistix, Visualization tools such as Power BI, Tableau.
Course Outcomes:

- Demonstrate competency in the application of supply chain management ideas within a commercial context.

Textbook

- Supply chain simulation and optimization with anyLogistix (2021) by Ivanov, Dmitry

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Professional Elective-I

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<tr>
<th>PEC-01</th>
<th>Professional Elective-I</th>
<th>3L:0T:0P</th>
<th>3 credits</th>
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</thead>
</table>

Choose Professional Elective-I subject from the list provided (Elective List: 1 to 17). The syllabus for each elective subject is provided at the end of the document.

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AICTE Model Curriculum for UG Degree Course in Logistics and Supply Chain Management
Digital Innovation and Technology in SCM

| PCC-23 | Digital Innovation and Technology in SCM | 3L:0T:0P | 3 credits |

Course Objectives:

- Introduce various digital technologies and innovations relevant to supply chain management.
- Explore strategies to integrate digital innovations for optimizing supply chain operations.
- Understand the impact of digital innovations on supply chain efficiency, transparency, and customer service.

Course Contents:
The following are the primary focuses of this course:

Importance of the digital revolution within supply chain partnerships, insight into the viewpoints, responsibilities, and choices of key stakeholders involved in reshaping supply chains in the digital age. Exploring the capabilities of digital supply chains, including enhancing visibility, flexibility, collaboration, and multichannel strategies. Examining the impact of technology, such as blockchain, the Internet of Things (IoT), artificial intelligence (AI), and digital twins, on supply chain processes and organizational structures. Analyzing digital platforms and assessing their performance. Investigating the challenges and opportunities presented by artificial intelligence-driven supply chains. Delving into the concepts of Industry 4.0 and the broader scope of digital transformation. Supply Chain Digitization: Unifying Demand, Data Integration, Effective Forecasting, Adaptability, Segmentation, Smart S&OP, Roadmap, Case Studies.

Course Outcomes:

- Explain various digital innovations and their relevance to supply chain management.
- Implement strategies to integrate digital technologies for optimizing supply chain operations.
- Assess the impact of digital innovations on supply chain efficiency and customer satisfaction.

Textbooks

- The digital supply chain (2022) by MacCarthy, Bart L., and Dmitry Ivanov

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Course Objectives:
- Introduce principles and practices of utilizing multiple transportation modes in logistics.
- Explore strategies for efficient containerization and its role in logistics operations.
- Understand how intermodal transportation and containerization enhance supply chain efficiency.

Course Contents:
The following are the primary focuses of this course:

What is intermodal transportation, Multimodal and Intermodal transport: principle models and basic ideas, Global container system, Infrastructure of intermodal transportation, Transport modes' role in intermodal transportation, Rail and Road Transportation, Intermodal movements between seaports and the inland (hinterland) issues and processes, Container terminal handling quality, Container handling in main ports, The Agile Port System, Technical and Concept Innovations and their impact on intermodal design and network bundling, Designing intermodal trans. Systems. Intermodal trans. Modeling, Interconnectivity, and interoperability Inter-organizational coordination and information technology. Containerization, Standard container, Tank container, Open top container, Flat container, Refrigerated container, Advantages and Challenges of Containerization, Economies of scale, Infrastructure costs and stacking, Intermodal Transport Costs.

Course Outcomes:
- Understand and explain principles governing the utilization of multiple transportation modes and containerization in logistics.
- Implement strategies for efficient intermodal transportation and containerization in logistics operations.
- Improve supply chain efficiency through the application of intermodal transportation and containerization.

Textbooks
Global Trade Management

**Course Objectives:**

- Introduce concepts and practices of managing global trade within supply chain operations.
- Understand international trade regulations and compliance requirements.
- Develop strategies to assess and mitigate risks in global trade operations.

**Course Contents:**
The following are the primary focuses of this course:

Comparative advantage: technology, factor proportions, Offshoring and outsourcing: offshoring, horizontal FDI, Vertical FDI, Customs controls: Export procedures and documents, Import procedures and documents, Methods of payments of Incoterms: Methods of payments, financing exporters and importers, instruments of payment, EXIM strategies and export marketing: EXIM business plan and strategy, export financing, import strategy, international marketing, Export incentive schemes: Duty exemption scheme, duty remission scheme, export promotion capital goods scheme, special economic zones.

**Course Outcomes:**

- Explain concepts and practices of managing global trade within supply chain operations.
- Ensure compliance with international trade regulations and requirements.
- Implement strategies to assess and mitigate risks in global trade operations.

**Textbooks**


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SDGs and Logistics

**Course Objectives:**

- Explore strategies to integrate sustainability practices within logistics and supply chain operations.
- Understand and apply ethical and environmental considerations in logistics and supply chain management.
Course Contents:

Introduction to SDGs and logistics, responsible supply chain management and ethical considerations within logistics, sustainable sourcing, eco-friendly packaging, social sustainability: employee rights, innovative working culture, fair treatment of workers, and community engagement, sustainable warehousing, procurement, Introduction to Logistics, Logistics System Design, Logistics Channels, Concept of Inventory related to logistics, Transit inventory, Warehousing, Warehousing decision models, Transportation models, Volume flow, India’s logistics transportation Sector and its challenges, Total logistics costs, Logistics metrics, Order Management, logistics information systems, Integration of all activities for effective supply chain performance, sustainable logistics, logistics 4.0, emerging trends in logistics.

Course Outcomes:

- Implement strategies to integrate sustainability practices within logistics operations.
- Apply ethical and environmental considerations in logistics and supply chain management.

Textbooks:

- An Illustrated Guide To Sustainable Development & Goals (2022) by Renu Paswan
- Logistics & Supply Chain Management, (2022), Martin Christopher, Prentice Hall.

**********

Professional Elective-II

| PEC-01 | Professional Elective-II | 3L:0T:0P | 3 credits |

Choose Professional Elective-II subject from the list provided (Elective List: 1 to 17). The syllabus for each elective subject is provided at the end of the document.

**********

Professional Elective-III

| PEC-03 | Professional Elective-III | 3L:0T:0P | 3 credits |

In semester Eight, Choose Professional Elective-III subject from the list provided (Elective List: 1 to 17). The syllabus for each elective subject is provided at the end of the document.

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Appendix – I

Open Electives

(SECTION I – Emerging Areas: Open Elective I & Open Elective III)

(SECTION II – Humanities & Social Science: Open Elective II)
AICTE Model Curriculum for UG Degree Course in Logistics and Supply Chain Management
### ‘Open Elective I’ & ‘Open Elective III’ on Emerging Areas

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<tr>
<th>S. No.</th>
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<th>Subject</th>
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<tbody>
<tr>
<td>1</td>
<td>Open Elective I or Open Elective III</td>
<td>3D Printing &amp; Design</td>
</tr>
<tr>
<td>2</td>
<td>Open Elective I or Open Elective III</td>
<td>Internet of Things</td>
</tr>
<tr>
<td>3</td>
<td>Open Elective I or Open Elective III</td>
<td>Artificial Intelligence</td>
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<tr>
<td>4</td>
<td>Open Elective I or Open Elective III</td>
<td>Quantum Computing</td>
</tr>
<tr>
<td>5</td>
<td>Open Elective I or Open Elective III</td>
<td>Cyber Security</td>
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<tr>
<td>6</td>
<td>Open Elective I or Open Elective III</td>
<td>Robotics</td>
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<tr>
<td>7</td>
<td>Open Elective I or Open Elective III</td>
<td>Virtual Reality</td>
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<td>8</td>
<td>Open Elective I or Open Elective III</td>
<td>Data Sciences</td>
</tr>
<tr>
<td>9</td>
<td>Open Elective I or Open Elective III</td>
<td>Block Chain</td>
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</table>

__SECTION I – Emerging Areas: Open Elective I & Open Elective III__

**3D Printing & Design**

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<th>Course Category</th>
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<td>OEXXX</td>
<td>3D Printing &amp; Design</td>
<td>3 (L: 3, T: 0, P: 0)</td>
<td>OE</td>
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</table>

**Course Objective:** The course is designed to impart knowledge and skills related to 3D printing technologies, selection of material and equipment and develop a product using this technique in Industry 4.0 environment.

**Course Content:**

**Module I: 3D Printing (Additive Manufacturing)**


**Module II: CAD for Additive Manufacturing**

CAD Data formats, Data translation, Data loss, STL format.

**Module III: Additive Manufacturing Techniques**

3.1 Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology.
3.2 Process, Process parameter, Process Selection for various applications.

**Module IV: Materials**

4.1 Polymers, Metals, Non-Metals, Ceramics
4.2 Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties.
4.3 Support Materials

**Module V: Additive Manufacturing Equipment**

5.1 Process Equipment- Design and process parameters  
5.2 Governing Bonding Mechanism  
5.3 Common faults and troubleshooting  
5.4 Process Design

**Module VI: Post Processing: Requirement and Techniques**

**Module VII: Product Quality**

7.1 Inspection and testing  
7.2 Defects and their causes

**Practicals**

1. 3D Modelling of a single component.  
2. Assembly of CAD modelled Components.  
3. Exercise on CAD Data Exchange.  
6. Printing of identified product on an available AM machine.  
7. Post processing of additively manufactured product.  
8. Inspection and defect analysis of the additively manufactured product.  
9. Comparison of Additively manufactured product with conventional manufactured counterpart.

**Text Books/References:**


**Alternative NPTEL/SWAYAM Course:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>NPTEL Course Name</th>
<th>Instructor</th>
<th>Host Institute</th>
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<tbody>
<tr>
<td>1</td>
<td>Rapid Manufacturing</td>
<td>Dr. Amandeep Singh, Prof. J. Ramkumar</td>
<td>IIT Kanpur</td>
</tr>
</tbody>
</table>

**Course Outcomes:** After completion of this course, the students will be able to:
Develop CAD models for 3D printing.
Import and Export CAD data and generate ‘.stl’ file.
Select a specific material for the given application.
Select a 3D printing process for an application.
Produce a product using 3D Printing or Additive Manufacturing (AM).

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Internet of Things

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<td>Course Title</td>
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<td>Number of Credits</td>
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<tr>
<td>Course Category</td>
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</table>

**Course Objective:** The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects.

**Course Content:**

**Module I: Introduction to IoT**
Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals - Devices and gateways, Data management, Business processes in IoT, Everything as a Service (XaaS), Role of Cloud in IoT, Security aspects in IoT.

**Module II: Elements of IoT**
Hardware Components - Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces.
Software Components - Programming API’s (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

**Module III: IoT Application Development**
Solution framework for IoT applications - Implementation of Device integration, Data acquisition and integration, Device data storage - Unstructured data storage on cloud/local server, Authentication, authorization of devices.

**Module IV: IoT Case Studies**
IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation.

**Practicals:**
1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when ‘1’/’0’ is received from smartphone using Bluetooth.
9. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud.
10. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.
11. To install MySQL database on Raspberry Pi and perform basic SQL queries.
12. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
13. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
14. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
15. Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.

**Text Books/References:**

1. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi
5. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs
7. Adrian McEwen, “Designing the Internet of Things”, Wiley
9. Cuno Pfister, “Getting Started with the Internet of Things”, O Reilly Media

**Alternative NPTEL/SWAYAM Course:**

<table>
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<tr>
<th>S. No.</th>
<th>NPTEL Course Name</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to internet of things</td>
<td>Prof. Sudip Misra</td>
<td>IIT Kharagpur</td>
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</tbody>
</table>
**Course Outcomes:** After the completion of this course, the students will be able to:
- Understand internet of Things and its hardware and software components.
- Interface I/O devices, sensors & communication Modules.
- Remotely monitor data and control devices.
- Develop real life IoT based projects.

**Artificial Intelligence**

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<tr>
<td>Course Title</td>
<td>Artificial Intelligence</td>
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<tr>
<td>Number of Credits</td>
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<td>Course Category</td>
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</table>

**Course Objectives:** Artificial Intelligence is a major step forward in how computer system adapts, evolves and learns. It has widespread application in almost every industry and is considered to be a big technological shift, similar in scale to past events such as the industrial revolution, the computer age, and the smart phone revolution.

This course will give an opportunity to gain expertise in one of the most fascinating and fastest growing areas of Computer Science through classroom program that covers fascinating and compelling topics related to human intelligence and its applications in industry, defence, healthcare, agriculture and many other areas. This course will give the students a rigorous, advanced and professional graduate-level foundation in Artificial Intelligence.

**Course Contents:**

**Module I: Introduction**
Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree.

**Module II: Search Algorithms**
Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search.

**Module III: Probabilistic Reasoning**
Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model.

**Module IV: Markov Decision process**
MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.

**Module V: Reinforcement Learning**
Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning.
Practicals:
1. Write a programme to conduct uninformed and informed search.
2. Write a programme to conduct game search.
3. Write a programme to construct a Bayesian network from given data.
4. Write a programme to infer from the Bayesian network.
5. Write a programme to run value and policy iteration in a grid world.
6. Write a programme to do reinforcement learning in a grid world.
7. Mini Project work.

Text Books/References:

Websites:
1. https://nptel.ac.in/courses/106105077
2. https://nptel.ac.in/courses/106106126
3. https://aima.cs.berkeley.edu
4. https://ai.berkeley.edu/project_overview.html (for Practicals)

Alternative NPTEL/SWAYAM Course:

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<tr>
<th>S. No.</th>
<th>NPTEL Course Name</th>
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<th>Host Institute</th>
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<tbody>
<tr>
<td>1</td>
<td>Fundamentals Of Artificial Intelligence</td>
<td>Prof. Shyamanta M. Hazarika</td>
<td>IIT Guwahati</td>
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</tbody>
</table>

Course Outcomes: After undergoing this course, the students will be able to:
- Build intelligent agents for search and games.
- Solve AI problems through programming with Python.
- Build Learning optimization and inference algorithms for model learning.
- Design and develop programs for an agent to learn and act in a structured environment.

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Quantum Computing

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<td>Course Title</td>
<td>:</td>
<td>Quantum Computing</td>
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<td>Course Category</td>
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</table>

Course Objective: The objective of this course is to impart necessary knowledge to the learner so that he/she can develop and implement algorithm and write programs using these algorithms.

Course Content:

Module I: Introduction to Quantum Computing
1.1 Motivation for studying Quantum Computing
1.2 Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.)
1.3 Origin of Quantum Computing
1.4 Overview of major concepts in Quantum Computing
   - Qubits and multi-qubits states, Bra-ket notation.
   - Bloch Sphere representation
   - Quantum Superposition
   - Quantum Entanglement

Module II: Math Foundation for Quantum Computing
Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.

Module III: Building Blocks for Quantum Program
1.1 Architecture of a Quantum Computing platform
1.2 Details of q-bit system of information representation:
   - Block Sphere
   - Multi-qubits States
   - Quantum superposition of qubits (valid and invalid superposition)
   - Quantum Entanglement
   - Useful states from quantum algorithmic perceptive e.g. Bell State
   - Operation on qubits: Measuring and transforming using gates.
   - Quantum Logic gates and Circuit: Pauli, Hadamard, phase shift, controlled gates, Ising, Deutsch, swap etc.
1.3 Programming model for a Quantum Computing Program
   - Steps performed on classical computer
   - Steps performed on Quantum Computer
   - Moving data between bits and qubits

Module IV: Quantum Algorithms
1.1 Basic techniques exploited by quantum algorithms.
   - Amplitude amplification
   - Quantum Fourier Transform
1.1 Introduction

- Phase Kick-back
- Quantum Phase estimation
- Quantum Walks

1.2 Major Algorithms

- Shor’s Algorithm
- Grover’s Algorithm
- Deutsch’s Algorithm
- Deutsch-Jozsa Algorithm

1.3 OSS Toolkits for implementing Quantum program

- IBM quantum experience
- Microsoft Q
- Rigetti PyQuil (QPU/QVM)

Practicals:

1. Building Quantum dice.
3. Composing simple quantum circuits with q-gates and measuring the output into classical bits.
4. Implementation of Shor’s Algorithms.
5. Implementation of Grover’s Algorithm.
6. Implementation of Deutsch’s Algorithm.
8. Mini Project such as implementing an API for efficient search using Grover’s Algorithm or Integer factorization using Shor’s Algorithm.

Text Books/References:

3. IBM Experience: https://quantumexperience.ng.bluemix.net

Alternative NPTEL/SWAYAM Course:

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<th>NPTEL Course Name</th>
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<th>Host Institute</th>
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<tbody>
<tr>
<td>1</td>
<td>Quantum Information and Computing</td>
<td>Prof.Dipan Ghosh</td>
<td>IIT Bombay</td>
</tr>
</tbody>
</table>

Course Outcomes: At the end of this course, the students will be able to

- Explain the working of a Quantum Computing program, its architecture and program model.
- Develop quantum logic gate circuits.
- Develop quantum algorithm.
- Program quantum algorithm on major toolkits.

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Cyber Security

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<td>Course Title</td>
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<td>Number of Credits</td>
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<td>Course Category</td>
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Course Objective:
The course has been designed to give students an extensive overview of cyber security issues, tools and techniques that are critical in solving problems in cyber security domains. The course aims at providing students with concepts of computer security, cryptography, digital money, secure protocols, detection and other security techniques. The course will help students to gauge understanding in essential techniques in protecting Information Systems, IT infrastructure, analysing and monitoring potential threats and attacks, devising security architecture and implementing security solutions. The students will also have a wider perspective to information security from national security perspective from both technology and legal perspective.

Course Content:
Module I: Cyber Security Concepts
Open Source/Free/Trial Tools: nmap, zenmap, Port Scanners, Network scanners.

Module II: Cryptography and Cryptanalysis
Open Source/Free/Trial Tools: Implementation of Cryptographic techniques, OpenSSL, Hash Values Calculations MD5, SHA1, SHA256, SHA 512, Steganography (Stools).

Module III: Infrastructure and Network Security
Open Source/Free/Trial Tools: DOS Attacks, DDOS attacks, Wireshark, Cain & abel, iptables/Windows Firewall, snort, suricata, fail2ban.

Module IV: Cyber Security Vulnerabilities & Safe Guards

Open Source/ Free/ Trial Tools: WinAudit, Zap proxy (OWASP), burp suite, DVWA kit.

**Module V: Malware**

Explanation of Malware, Types of Malware: Virus, Worms, Trojans, Rootkits, Robots, Adware's, Spywares, Ransomwares, Zombies etc., OS Hardening (Process Management, Memory Management, Task Management, Windows Registry/services another configuration), Malware Analysis.


**Module VI: Security in Evolving Technology**


**Module VII: Cyber Laws and Forensics**


Open Source/ Free/ Trial Tools: Case Studies related to Cyber Law, Common Forensic Tools like dd, md5sum, sha1sum, Ram dump analysis, USB device.

**Practicals:**

1. Implementation to gather information from any PC's connected to the LAN using whois, port scanners, network scanning, Angry IP scanners etc.
2. Implementation of Symmetric and Asymmetric cryptography.
3. Implementation of Steganography.
5. Implementation of Windows security using firewall and other tools.
6. Implementation to identify web vulnerabilities, using OWASP project.
7. Implementation of IT Audit, malware analysis and Vulnerability assessment and generate the report.
8. Implementation of OS hardening and RAM dump analysis to collect the Artifacts and other information’s.
9. Implementation of Mobile Audit and generate the report of the existing Artifacts.
10. Implementation of Cyber Forensics tools for Disk Imaging, Data acquisition, Data extraction and Data Analysis and recovery.
Text Books/References:
7. V.K. Pachghare, “Cryptography and Information Security”, PHI Learning

Web link: [http://www.ignou.ac.in/upload/Announcement/programmedetails.pdf](http://www.ignou.ac.in/upload/Announcement/programmedetails.pdf)

Alternative NPTEL/SWAYAM Course:

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<th>Host Institute</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to Information Security I</td>
<td>Prof. V. Kamakoti</td>
<td>IIT MADRAS</td>
</tr>
</tbody>
</table>

Course Outcomes: After completion of this course, the students should be able to:

- Understand, appreciate, employ, design and implement appropriate security technologies and policies to protect computers and digital information.
- Identify & Evaluate Information Security threats and vulnerabilities in Information Systems and apply security measures to real time scenarios.
- Identify common trade-offs and compromises that are made in the design and development process of Information Systems.
- Demonstrate the use of standards and cyber laws to enhance information security in the development process and infrastructure protection.

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Robotics

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</table>

Course Objective:
The objective of this course is to impart knowledge about industrial robots for their control and design.

Course Content:
Module I: Introduction to Robotics
- Types and components of a robot, Classification of robots, closed-loop and open loop control systems.
• Kinematics systems; Definition of mechanisms and manipulators, Social issues and safety.

Module II: Robot Kinematics and Dynamics
• Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Jacobian, Singularity, and Statics
• Dynamic Modelling: Equations of motion: Euler-Lagrange formulation

Module III: Sensors and Vision System
• Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc.
• Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations
• Vision applications in robotics.

Module IV: Robot Control
• Basics of control: Transfer functions, Control laws: P, PD, PID.
• Non-linear and advanced controls.

Module V: Robot Actuation Systems

Module VI: Control Hardware and Interfacing
Embedded systems: Architecture and integration with sensors, actuators, components, Programming for Robot Applications.

Practicals:
1. Study components of a real robot and its DH parameters.
2. Forward kinematics and validate using a software (Robo Analyser or any other free software tool).
3. Inverse kinematics of the real robot and validation using any software.
4. Use of open source computer vision programming tool openCV.
5. Image Processing using openCV.
7. Positioning and orientation of robot arm.
8. Control experiment using available hardware or software.
9. Integration of assorted sensors (IR, Potentiometer, strain gages etc.), micro controllers and ROS (Robot Operating System) in a robotic system.
10. Project work

Text Books/References:

**Alternative NPTEL/SWAYAM Course:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>NPTEL Course Name</th>
<th>Instructor</th>
<th>Host Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Robotics</td>
<td>Prof. Dilip Kumar Pratihar</td>
<td>IIT Kharagpur</td>
</tr>
</tbody>
</table>

**Course Outcomes:** After the completion of this course, the students will be able to
- Perform kinematic and dynamic analyses with simulation.
- Design control laws for a robot.
- Integrate mechanical and electrical hardware for a real prototype of robotic device.
- Select a robotic system for given application.

*****

**Virtual Reality**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>:</th>
<th>OEXXX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>:</td>
<td>Virtual Reality</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>:</td>
<td>3 (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Course Category</td>
<td>:</td>
<td>OE</td>
</tr>
</tbody>
</table>

**Course Objective:** The objective of this course is to provide a detailed understanding of the concepts of Virtual Reality and its applications

**Course Content:**

**Module I: Introduction to Virtual Reality**

**Module II: 3D Computer Graphics**
Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, Simple 3D modelling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism-Stereographic image.

**Module III: Geometric Modelling**
Geometric Modelling: Introduction, From 2D to 3D, 3D space curves, 3D boundary representation.


Module IV: Virtual Environment

Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object inbetweening, free from deformation, particle system.


Module V: VR Hardware and Software

Human factors: Introduction, the eye, the ear, the somatic senses.

VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems.

VR Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML.

Module VI: VR Applications


The Future: Virtual environment, modes of interaction.

Practicals

1. Developing architecture of a house using Virtual Reality.
2. Perform CRO based experiment using Virtual Reality.
6. Simulation of circulation of blood in heart.
7. Simulation of Fight/Vehicle/Space Station.
9. Developing concept of Virtual class room with multiplayer.

Text Books/References:

6. www.vresources.org
7. www.vrac.iastate.edu
8. www.w3.org/MarkUp/VRM

Alternative NPTEL/SWAYAM Course:
### Course Outcomes:
At the end of the course, the students will be able to:
- Understand geometric modelling and Virtual environment.
- Study about Virtual Hardware and Software
- Develop Virtual Reality applications.

### Data Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Number of Credits</th>
<th>Course Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>OEXXX</td>
<td>Data Sciences</td>
<td>3 (L: 3, T: 0, P: 0)</td>
<td>OE</td>
</tr>
</tbody>
</table>

### Course Objective:
The objective of this course is to impart necessary knowledge of the mathematical foundations needed for data science and develop programming skills required to build data science applications.

### Course Content:

#### Module I: Introduction to Data Science:
- Concept of Data Science, Traits of Big data, Web Scraping, Analysis vs Reporting.

#### Module II: Introduction to Programming Tools for Data Science:
- 1.1 Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK
- 1.2 Visualizing Data: Bar Charts, Line Charts, Scatterplots
- 1.3 Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction.

#### Module III: Mathematical Foundations
- 1.4 Linear Algebra: Vectors, Matrices.
- 1.5 Statistics: Describing a Single Set of Data, Correlation, Simpson’s Paradox, Correlation and Causation.
- 1.7 Hypothesis and Inference: Statistical Hypothesis Testing, Confidence Intervals, Phacking, Bayesian Inference.

#### Module IV: Machine Learning
- Overview of Machine learning concepts – Over fitting and train/test splits, Types of Machine learning – Supervised, Unsupervised, Reinforced learning, Introduction to Bayes Theorem, Linear Regression- model assumptions, regularization (lasso, ridge, elastic net), Classification and Regression algorithms- Naïve Bayes, K-Nearest Neighbors, logistic regression, support
vector machines (SVM), decision trees, and random forest, Classification Errors, Analysis of Time Series- Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural Networks Learning And Generalization, Overview of Deep Learning.

**Module V: Case Studies of Data Science Application**
Weather forecasting, Stock market prediction, Object recognition, Real Time Sentiment Analysis.

**Practicals:**
1. Write a programme in Python to predict the class of the flower based on available attributes.
2. Write a programme in Python to predict if a loan will get approved or not.
3. Write a programme in Python to predict the traffic on a new mode of transport.
4. Write a programme in Python to predict the class of user.
5. Write a programme in Python to identify the tweets which are hate tweets and which are not.
6. Write a programme in Python to predict the age of the actors.
7. Mini project to predict the time taken to solve a problem given the current status of the user.

**Text Books/References:**
1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media

**Alternative NPTEL/SWAYAM Course:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>NPTEL Course Name</th>
<th>Instructor</th>
<th>Host Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Data Science for Engineers</td>
<td>Prof. Shankar Narasimhan, Prof. Raganathan Rengasamy</td>
<td>IIT MADRAS</td>
</tr>
</tbody>
</table>

**Course Outcomes:** At end of this course, the students will be able to

- Demonstrate understanding of the mathematical foundations needed for data science.
- Collect, explore, clean, munge and manipulate data.
- Implement models such as k-nearest Neighbors, Naive Bayes, linear and logistic regression, decision trees, neural networks and clustering.
- Build data science applications using Python based toolkits.
**Course Objective:** The objective of this course is to provide conceptual understanding of how block chain technology can be used to innovate and improve business processes. The course covers the technological underpinning of block chain operations in both theoretical and practical implementation of solutions using block chain technology.

**Course Content:**

**Module I: Introduction**
Introduction: Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Crypto currency to Block chain, Permissioned Model of Block chain, Overview of Security aspects of Block Chain.

Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic cryptocurrency.

**Module II: Understanding Block chain with Crypto currency**
Bitcoin and Block chain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.


**Module III: Understanding Block chain for Enterprises**
Permissioned Block chain: Permissioned model and use cases, Design issues for Permissioned block chains, Execute contracts, State machine replication, Overview of Consensus models for permissioned block chain- Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.

Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Block chain.

**Module IV: Block chain application development**
Practicals:

1. Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on Cloud to run.
   - [https://github.com/hyperledger/](https://github.com/hyperledger/)
   - [https://docs.docker.com/get-started/](https://docs.docker.com/get-started/)
   - [https://console.bluemix.net/docs/containers/container_index.html#container_index](https://console.bluemix.net/docs/containers/container_index.html#container_index)


Mini projects such as:


**Text Books/References:**
4. Josh Thompsons, “Block Chain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming”

**Alternative NPTEL/SWAYAM Course:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>NPTEL Course Name</th>
<th>Instructor</th>
<th>Host Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to Blockchain Technology and Applications</td>
<td>Prof. Sandeep Shukla</td>
<td>IIT KANPUR</td>
</tr>
</tbody>
</table>

**Course Outcomes:** At the end of this course, the students will be able to:
- Understand block chain technology.
- Develop block chain based solutions and write smart contract using Hyperledger Fabric and Ethereum frameworks.
- Build and deploy block chain application for on premise and cloud based architecture.
- Integrate ideas from various domains and implement them using block chain technology in different perspectives.

******
SECTION II – Humanities & Social Science

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Available to be taken as</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Open Elective II (Take Any One)</td>
<td>Sports and Yoga</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Engineering Economics</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Human Relations at Work</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Values and Ethics</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Intellectual Property Rights</td>
</tr>
</tbody>
</table>

Sports and Yoga

Course Code : OEXXX  
Course Title : Sports and Yoga  
Number of Credits : 3 (L: 3, T: 0, P: 0)  
Course Category : OE

Course Objectives:
- To make the students understand the importance of sound health and fitness principles as they relate to better health.
- To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.
- To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury.
- To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

Course Content:
**Module I: Introduction to Physical Education**
- Meaning & definition of Physical Education
- Aims & Objectives of Physical Education
- Changing trends in Physical Education

**Module II: Olympic Movement**
- Ancient & Modern Olympics (Summer & Winter)
- Olympic Symbols, Ideals, Objectives & Values
- Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhyan Chand Award, Rajiv Gandhi Khel Ratna Award etc.)

**Module III: Physical Fitness, Wellness & Lifestyle**
- Meaning & Importance of Physical Fitness & Wellness
- Components of Physical fitness
AICTE Model Curriculum for UG Degree Course in Logistics and Supply Chain Management

- Components of Health related fitness
- Components of wellness
- Preventing Health Threats through Lifestyle Change
- Concept of Positive Lifestyle

**Module IV: Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga**

- Define Anatomy, Physiology & Its Importance

**Module V: Kinesiology, Biomechanics & Sports**

- Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports
- Newton's Law of Motion & its application in sports.
- Friction and its effects in Sports.

**Module VI: Postures**

- Meaning and Concept of Postures.
- Causes of Bad Posture.
- Advantages & disadvantages of weight training.
- Concept & advantages of Correct Posture.
- Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis.
- Corrective Measures for Postural Deformities

**Module VII: Yoga**

- Meaning & Importance of Yoga
- Elements of Yoga
- Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas
- Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana)
- Relaxation Techniques for improving concentration - Yog-nidra

**Module VIII: Yoga & Lifestyle**

- Asanas as preventive measures.
- Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.
- Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.

**Module IX: Training and Planning in Sports**
Module X: Psychology & Sports
- Definition & Importance of Psychology in Physical Edu. & Sports
- Define & Differentiate Between Growth & Development
- Adolescent Problems & Their Management
- Emotion: Concept, Type & Controlling of emotions
- Meaning, Concept & Types of Aggressions in Sports.
- Psychological benefits of exercise.
- Anxiety & Fear and its effects on Sports Performance.
- Motivation, its type & techniques.
- Understanding Stress & Coping Strategies.

Module XI: Doping
- Meaning and Concept of Doping
- Prohibited Substances & Methods
- Side Effects of Prohibited Substances

Module XII: Sports Medicine
- First Aid – Definition, Aims & Objectives.
- Sports injuries: Classification, Causes & Prevention.
- Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries

Module XIII: Sports / Games
- Following sub topics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc.
- History of the Game/Sport.
- Specifications of Play Fields and Related Sports Equipment.
- Important Tournaments and Venues.
- Sports Personalities.
- Proper Sports Gear and its Importance.

References:
1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga By B.K.S. Iyengar.
3. Health and Physical Education – NCERT (11th and 12th Classes)

Course Outcomes: On successful completion of the course the students will be able to
- Practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation.
AICTE Model Curriculum for UG Degree Course in Logistics and Supply Chain Management

- Learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.
- Learn breathing exercises and healthy fitness activities.
- Understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.
- Perform yoga movements in various combination and forms.
- Assess current personal fitness levels.
- Identify opportunities for participation in yoga and sports activities.
- Develop understanding of health-related fitness components: cardiorespiratory endurance, flexibility and body composition etc.
- Improve personal fitness through participation in sports and yogic activities.
- Develop understanding of psychological problems associated with the age and lifestyle.
- Demonstrate an understanding of sound nutritional practices as related to health and physical performance.
- Assess yoga activities in terms of fitness value.
- Identify and apply injury prevention principles related to yoga and physical fitness activities.
- Understand and correctly apply biomechanical and physiological principles related to exercise and training.

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Engineering Economics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>OEXXX</th>
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</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Engineering Economics</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Course Category</td>
<td>OE</td>
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</tbody>
</table>

This courses is strongly recommended for UG LSCM Engineering Students.

Course Objective(s):
1. This course aims at providing the student with advanced concepts of engineering economic analysis and its role in engineering decision making.
2. Additionally, the course also covers topics such as depreciation, after tax analysis, replacement analysis, uncertainty, inflation, deflation, and estimation of future events.

Course Content:
- **Module I: Introduction**: Definition – Nature – Scope and Significance of Economics for Engineers.


Text Books:

References:

Alternative NPTEL/SWAYAM Course:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>NPTEL Course Name</th>
<th>Instructor</th>
<th>Host Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Managerial Economics</td>
<td>Dr. Trupti Mishra</td>
<td>IIT Bombay</td>
</tr>
</tbody>
</table>

Course Outcome(s):
1. Describe the role of economics in the decision making process and perform calculations in regard to interest formulas.
2. Estimate the Present, annual and future worth comparisons for cash flows.
3. Calculate the rate of return, depreciation charges and income taxes.
4. Enumerate different cost entities in estimation and costing.
5. Explain the importance of finance functions, financial ratios and solve related problems.
6. Explain the elements of budgeting and benchmarking.

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Human Relations at Work

<table>
<thead>
<tr>
<th>Course Code</th>
<th>OEXXX</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Human Relations at Work</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Course Category</td>
<td>OE</td>
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</tbody>
</table>

Course Objective(s):
1. The quality of the organization’s employees, their attitude, behavior and satisfaction with their jobs, and their behavior towards ethics and values and a sense of fair treatment all impact the firm's productivity, level of customer service, reputation, and survival.
2. The students of human resources management must aware of basic aspects of human resource management to understand the functioning of human resource management in an organizational setting.

Course Content:


Module III: Work Environment: Good housekeeping practices - Design of work place - Fatigue - Causes and prevention and their importance - Leadership - Types and Theories of leadership.

Module IV: Group Dynamics: Cohesiveness - Co-operation - Completion - Conflict - Resolution - Sociometry - Group forms - Role position status.

Module V: Organizational Culture and Climate: Organizational effectiveness - Organizational Development. Counselling and guidance - Importance of Counsellor - Types of Counselling - Information needed for Counselling.

Text Books:
2. Diwedi - Human Relation and Organizational Behavior, MacMillan India.
3. Aswathappa - Organizational Behavior.
4. Sekaran - Organizational Behavior.

References:
1. Arnold - Work Psychology, MacMillan I Ltd.
2. Hippo - Organizational Behavior.
3. Heresy Bianchand - Introduction to organizational Behavior.
4. Hanell - Industrial Psychology.
5. Keith Davis - Human Relations at work.

**Course Outcome(s):**
1. Understand the basic concepts, functions and processes of human resource management.
2. Recognize the role, functions and functioning of human resource department of the organizations.
3. Design and formulate various HRM processes such as Recruitment, Selection, Training, Development, Performance appraisals and Reward Systems, Compensation Plans and Ethical Behaviour.
4. Develop ways in which human resources management might diagnose a business strategy and then facilitate the internal change necessary to accomplish the strategy.
5. Evaluate the developing role of human resources in the global arena.

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**Values and Ethics**

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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Values and Ethics</td>
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<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Course Category</td>
<td>OE</td>
</tr>
</tbody>
</table>

**Course Objective(s):**
1. To increase ethical sensitivity.
2. To impart ethical knowledge.
3. To improve ethical judgment.

**Course Content:**


**Module III: Engineering as Social Experimentation:** Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.


Text Books:

References:

Alternative NPTEL/SWAYAM Course:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>NPTEL Course Name</th>
<th>Instructor</th>
<th>Host Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ethics in Engineering Practice</td>
<td>Dr. Susmita Mukhopadhyay</td>
<td>IIT Kharagpur</td>
</tr>
</tbody>
</table>

Course Outcome(s):
1. Recognize Ethical, social and environmental issues.
2. Recognize Engineer’s rights and responsibilities act in morally desirable ways, towards moral commitment and responsible conduct.
3. Integrate academic learning with experimental learning in a profession.

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Intellectual Property Rights

<table>
<thead>
<tr>
<th>Course Code</th>
<th>OEXXX</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Intellectual Property Rights</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Course Category</td>
<td>OE</td>
</tr>
</tbody>
</table>

Course Objective:
To promote the dissemination of the knowledge in intellectual properties by affording protection to its creators and its applications relevant to various streams of Engineering and Technology.
Course Content:


**Module II: INTERNATIONAL SCENARIO:** International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.


**Module IV: NEW DEVELOPMENTS IN IPR:** Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR – patent corporation treaty (PCT)- patent laboratory treaty

**Module V: LEGAL PROCEDURE:** Registered and unregistered trademarks, design, concept, idea patenting

**TEXTBOOKS:**

**REFERENCES:**

**Alternative NPTEL/SWAYAM Course:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>NPTEL Course Name</th>
<th>Instructor</th>
<th>Host Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction on Intellectual Property to Engineers and Technologists</td>
<td>Prof. Tapas Kumar Bandyopadhyay</td>
<td>IIT Kharagpur</td>
</tr>
</tbody>
</table>

**Course Outcome:**

1. To give an understanding of Intellectual Property Rights, Patents.
2. To familiarise the students to what constitutes professional practice, introduction of various stakeholders and their respective roles; understanding the fundamental ethics governing the profession
3. To develop good ideas of the legal and practical aspects of their profession.

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Appendix – II

Professional Electives

Professional Electives (I to III)

<table>
<thead>
<tr>
<th>Course Codes</th>
<th>PEC I, PEC II, PEC III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit distribution for any Professional Elective Course</td>
<td>3 (L: 3, T: 0, P: 0)</td>
</tr>
</tbody>
</table>

Important Note:
For Professional Elective Courses (Professional Elective I to III), a student has to opt any one of the course as defined in Appendix II, one at a time.

List of Elective Courses

1. Supply Chain Analytics
2. Reverse Logistics
3. Lean Six Sigma in Logistics and Supply Chain
4. Retail Supply Chain Management
5. Humanitarian Logistics
6. Emerging Technologies in SCM
7. Agile project management
8. Competitive strategy for the supply chain
9. Green Transportation economics
10. Green supply chain management
11. Business law and ethics
12. Storage systems and equipment for warehouse 4.0
13. Industry 5.0
14. Robotics Process Automation
15. Stochastic operation research
16. Consumer choice models
17. Dynamic pricing and revenue management
Syllabus for elective subjects:

1. Supply Chain Analytics:

Objectives:
- Utilise data analytics and its real-world applications to improve decision-making in the supply chain.
- Examine data from across various supply chain partners to increase efficacy and efficiency.
- Utilise analytics in the supply chain to forecast and make proactive decisions.

Course Content:

The following is the primary focus of the course:
Discuss supply chain integration, Scope for supply chain analytics based on facilities location, inventory planning, transportation and distribution, information sharing, sourcing & procurement, pricing, etc. Based on uncertainty and dynamic environment. Optimization and trade-off analysis in centralization / decentralization, cross-docking, nearshore / offshore manufacturing, responsiveness / efficiency, etc.

Outcomes:
- Use an analytical understanding to guide you in making sound decisions.
- Make better use of data analysis to achieve more efficiency throughout the supply chain.
- Develop models of forecasting for different situations that include supply chains.

Textbooks:

2. Reverse Logistics:

Objectives:
- Acquire strategies for handling returns and the procedures involved in reverse logistics.
- Provide strategies to cut back on reverse logistics expenses.

Course Content:
The following is the primary focus of the course: Structural and Infrastructural differences between Forward Logistics and Reverse Logistics, Organization of reverse logistics – Strategic, Tactical, Operational level challenges, Mathematics of reverse logistics – network design, Customer relationships in reverse logistics, Employee relationships in reverse logistics, Sustainability and Reverse Logistics.
Outcomes:
- Simplify the procedures for handling returned merchandise.
- Reduce the amount of money spent on reverse logistics activities.

Textbooks:

3. **Lean Six Sigma in Logistics and Supply Chain:**

Objectives:
- To understand Lean Six Sigma techniques to optimize supply chain operations.
- To understand the strategies to improve the quality level of goods and services in the supply chain.
- Reduce wastage and inefficiencies in all aspects of the supply chain.

Course Content:
The following is the primary focus of the course:
Introduction to Lean Six Sigma, Various tools in Lean Six Sigma. The DMAIC process, Specific application of Lean six Sigma to Logistics and supply chain management.

Outcomes:
- Apply Lean Six Sigma techniques to enhance processes.
- Reduce waste and improve the effectiveness of operations.

Textbooks:

4. **Retail Supply Chain Management:**

Objectives:
- Understand and manage inventory effectively within retail operations.
- To develop strategies for accurate demand forecasting in the retail sector.
Course Content:
The following is the primary focus of the course: Challenges for Retail Logistics, Brick and mortar versus E-tail logistics, Global Aspects in Retail Supply Chains, Supply chains for fashion footwear & luxury items, Supply chains for food products, Merchandizing, Sustainability in the retail supply chain.

Outcomes:
- Improve inventory levels for efficient retail operations.
- Forecast demand accurately to meet customer needs.
- Determine collaborative relationships with suppliers for retail success.

Textbooks:

5. Humanitarian Logistics:

Objectives:
- To understand strategies for effective logistics during humanitarian crises.
- To understand the significance of the resilience of supply chains in humanitarian contexts.
- To know the role of Efficiently allocating resources for humanitarian aid delivery.

Course Content:
The following is the primary focus of the course:
Introduction to humanitarian logistics, Humanitarian issues in general – natural disasters – earthquakes, hurricanes, famines, floods, etc., civil wars and migrants issues, asylum seekers, etc., Logistics requirement in various humanitarian crises, Role of local, provincial / State, and Federal / Central Government, Role of NGOs, Logistics Decision support systems, Resource requirement, resource planning, Optimization and Cost analysis.

Outcomes:
- Implement logistical strategies for disaster response.
- Develop supply chains capable of withstanding crises.
- Allocate resources efficiently for humanitarian aid.

Textbooks:

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6. Emerging Technologies in SCM

Objectives:
- To understand the implications of emerging tech like IoT, AI, and blockchain in supply chains.
- To develop an understanding of supply chain operations through technology adoption.

Course Content:
The following is the primary focus of the course:
Digital transformation of supply chain relationships. In-depth understanding of the perspectives, roles, and decisions of relevant stakeholders in transforming supply chains in the digital era. Digital supply chain capabilities (Visibility, Agility, Collaboration, Omnichannel), the role of technology (Blockchain, IoT, AI, Digital Twins), processes and organizations, as well as digital platforms and performance. Artificial Intelligence Driven SCs: Challenges and Opportunities.

Industry 4.0 and Digital Transformation. Supply Chain Digitization: Unified View of Demand, Understand how to integrate internal and external data, Develop an Effective demand forecasting process that brings together supply planning, financial planning, sales, and trade planning, Understand effective mechanisms to ensure adaptability, Supply Chain Segmentation, Smart S&OP, Smart Execution, and Control Tower, Develop a roadmap for a successful supply chain digitization: The Journey to Success; Organizational structure; Change Management. Relevant case studies of digitally transformed supply chains, long-term competitive advantage of successful case studies, through operations and digital enhanced value generation.

Outcomes:
- Apply and make use of cutting-edge technology in supply chain management.
- Boost agility and efficiency by implementing technology.
- Foster an innovative culture to support further tech adoption.

Textbooks

7. Agile project management

Objectives:
- To understand methodologies for agile project management.
- To understand the various project management approaches within supply chains.

Course Content:
The following is the primary focus of the course:
Introduction to Agile project management; Agile Principles and Mindset; Agile Methodologies; Value Driven Delivery; Leadership and team performance; Adaptive Planning; Continuous Improvement; Stakeholder Engagement; Lean Thinking; Agile Leadership and Culture; Agile Project Management Tools.

Outcomes:
- Implement agile methodologies for adaptable supply chain processes.
- Develop the capability to swiftly respond to changing market dynamics.

Textbooks:

8. Competitive Strategy for the Supply Chain:

Objectives:
- To understand the competitive strategies within the context of supply chain management.
- To gain an understanding of the strategies to differentiate the supply chain for competitive advantage.

Course Content:
The following is the primary focus of the course:
Strategy driven supply chain, Roadmap and design for Supply Chain strategies, Integrating design with Execution, Processes, People, and Finance, Towards Excellence and Sustainability in Supply Chain Strategy.

Outcomes:
- To align supply chain strategies with overall business goals.
- To develop supply chain strategies that offer a competitive advantage.

Textbooks:
9. Green Transportation Economics:

Objectives:
- To understand the various sustainable and eco-friendly transportation options.
- To develop a basic understanding of economic viability while considering environmental impact.
- To understand and comply with regulations for green transportation.

Course Content:
The following is the primary focus of the course:
Importance of green logistics and transportation, Impact of collection points and warehouses on economics and sustainability, Sustainability and green transport fleet selection, Economics, and environmental trade-off in all four modes of transport – air, water, rail, road.

Outcomes:
- Ensure compliance with environmental regulations in transportation.

Textbooks:

10. Green supply chain management

Objectives:
- To understand the impact of the ecological footprint across the supply chain.
- To understand the role of stakeholders in commitment to green supply chain initiatives.

Course Content:
The following is the primary focus of the course:
What is green supply chain management? Supplier collaboration and development for Green SCM, Green procurement and purchasing practices, Regional and global level sustainability differences and practices, closing the loop – green reverse logistics.

Outcomes:
- Reduce the environmental impact associated with supply chain operations.
- Implement sustainable practices in every stage of the supply chain.
- Facilitate stakeholder participation in endorsing green supply chain initiatives.
11. Business law and ethics

Objectives:
- To understand legal frameworks governing business and supply chain operations.
- To understand the strategies to mitigate legal and ethical risks within supply chains.

Course Content:
The following is the primary focus of the course:

Introduction to business laws and ethics, theories of business ethics, ethical dilemmas, ethical decision, globalisation, and business Ethics, corporate ethics, corporate social responsibility, ethics of consumer protection, environmental ethics, role of various agencies in ensuring ethics in organization, ethics and Indian business, marketing ethics.

Outcomes:
- Comply with legal and ethical considerations in business and supply chain decisions.
- Strategies to mitigate legal and ethical risks effectively within supply chains.

Textbooks

12. Storage systems and equipment for warehouse 4.0

Objectives:
- To understand the modern storage systems and equipment for advanced warehouses.
- To understand various approaches to enhance warehouse operations and productivity.
- To understand the implications of Industry 4.0 technologies for warehouse operations.

Course Content:
The following is the primary focus of the course:

Warehouse structure and design, Receiving and put away, Smart pallete storage and handling systems, Use of Robots as AGVs in warehouses, Case picking, Handling of atypical conditions – spillage, breakage, etc., Digital systems in warehouses and material handling.
Outcomes:

- Implement modern storage systems for efficient warehouse operations.
- Align warehouse technology with Industry 4.0 standards.

Textbooks:


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13. Industry 5.0

Objectives:

- To understand the evolution and future of manufacturing in the Industry 5.0 ecosystem.
- To understand the strategies to enhance human workers and advanced technologies collaboration.

Course Content:
The following is the primary focus of the course:

Evolution of Industrial revolutions, Industry 4.0 and Industry 5.0, Transformation of Industry 5.0 in various sectors – Automotive, Heavy engineering, Light engineering, Hi-Tech electronics manufacturing, Effect on allied sectors – healthcare, transportation, logistics, etc.

Outcomes:

- To develop strategies to ready for the next wave of industrial revolution in manufacturing.
- To introduce innovative and sustainable practices within Industry 5.0.

Textbooks:


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14. Robotics Process Automation

Objectives:

- To understand the implications of adopting robotic solutions for automating supply chain and logistics processes.

Course Content:
The following is the primary focus of the course:
Automation of Routine Tasks with Robots, Sequence, Flowchart, Control Flow, Memorise, and Data Manipulation, manage incoming User Requests and Helper Robots, Handling Errors, Debugging, and Logging, Controlling, and updating the software, The bot’s deployment, and upkeep.

Outcomes:

- Apply robotics to automate various supply chain and logistics tasks.
- Improve efficiency and accuracy through robotics process automation.
- Reduce errors and risks associated with manual processes.

Textbooks

- Introduction To Robotics Process Automation (2023) by Abhishek Arora and Dr. Ruchi Kawatra

15. Stochastic operation research

Objectives:

- To understand the different probability and statistical methods for supply chain decision-making.
- To understand the strategies for managing uncertainties within supply chain operations.

Course Content:
The following is the primary focus of the course:
Introduction to Advanced Operations Research; Problem Formulation and Model Building Techniques; Introduction to Nonlinear Programming and Convex Optimization; Duality and Sensitivity Analysis; Integer Linear Programming and Mixed-Integer Linear Programming (MILP); Network Optimization: Shortest Path, Max Flow, and Assignment Problems; Unconstrained Optimization: Gradient Descent, Newton's Method; Constrained Optimization: Lagrange Multipliers, KKT Conditions; Convex Optimization: Properties, Algorithms, and Applications; Introduction to Stochastic Processes; Stochastic Programming: Two-Stage and Multi-Stage Problems; Markov Decision Processes and Reinforcement Learning; Multi-Objective Optimization; Pareto Optimality and Efficiency; Goal Programming; Evolutionary Algorithms for Multi-Objective Optimization; Introduction to Game Theory; Cooperative and Non-Cooperative Games; Applications of Game Theory in Supply Chain; Monte Carlo Simulation; Discrete-Event Simulation for Complex Systems.

Outcomes:

- Apply probability models to address uncertainties in supply chains.
- Analyze and mitigate risks associated with uncertain supply chain variables.
- Develop strategies for optimizing operations under uncertainty.
16. Consumer choice models:

Objectives:
- To understand the various factors influencing consumer choices in supply chains.
- To develop an understanding of the models to predict and understand consumer preferences.

Course Content:
The following is the primary focus of the course:

Fundamental principles of consumer behavior, utility theory, preferences, and decision-making processes, cognitive and psychological factors, segmentation, biases, branding, pricing, and digital influences, ethical and sustainability considerations, emerging trends like neuromarketing.

Outcomes:
- Understand factors influencing consumer choices within supply chains.
- Predict consumer preferences to align supply chain strategies.
- Develop strategies based on insights derived from consumer choice models.

Textbooks

17. Dynamic pricing and revenue management:

Objectives:
- To understand the importance of dynamic pricing models for maximizing revenue in supply chains.
- To understand the strategies to optimize revenue through pricing mechanisms.

Course Content:
The following is the primary focus of the course:
Introduction to Revenue Management, Predicting Demand, Foundations of Pricing, Dynamic Pricing Approaches, economics for dynamic pricing and revenue management, demand forecasting, optimization for Revenue Management and network revenue management.

Outcomes:

- Apply pricing strategies responsive to market dynamics.
- Adjust pricing strategies in response to market fluctuations.

Textbooks


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Appendix – III

A Guide to Induction Program
AICTE Model Curriculum for UG Degree Course in Logistics and Supply Chain Management
Appendix – III: A Guide to Induction Program

1. Introduction

(Induction Program was discussed and approved for all colleges by AICTE in March 2017. It was discussed and accepted by the Council of IITs for all IITs in August 2016. It was originally proposed by a Committee of IIT Directors and accepted at the meeting of all IIT Directors in March 2016.\(^1\) This guide has been prepared based on the Report of the Committee of IIT Directors and the experience gained through its pilot implementation in July 2016 as accepted by the Council of IITs. Purpose of this document is to help institutions in understanding the spirit of the accepted Induction Program and implementing it.)

Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond.

The graduating student must have knowledge and skills in the area of his study. However, he must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he would understand and fulfill his responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.

There is a mad rush for engineering today, without the student determining for himself his interests and his goals. This is a major factor in the current state of demotivation towards studies that exists among UG students.

The success of gaining admission into a desired institution but failure in getting the desired branch, with peer pressure generating its own problems, leads to a peer environment that is demotivating and corrosive. Start of hostel life without close parental supervision at the same time, further worsens it with also a poor daily routine.

To come out of this situation, a multi-pronged approach is needed. One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character.

\(^1\)A Committee of IIT Directors was setup in the 152nd Meeting of IIT Directors on 6th September 2015 at IIT Patna, on how to motivate undergraduate students at IITs towards studies, and to develop verbal ability. The Committee submitted its report on 19th January 2016. It was considered at the 153rd Meeting of all IIT Directors at IIT Mandi on 26 March 2016, and the accepted report came out on 31 March 2016. The Induction Program was an important recommendation, and its pilot was implemented by three IITs, namely, IIT(BHU), IIT Mandi and IIT Patna in July 2016. At the 50th meeting of the Council of IITs on 23 August 2016, recommendation on the Induction Program and the report of its pilot implementation were discussed and the program was accepted for all IITs.
2. Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days.

We propose a 3-week long induction program for the UG students entering the institution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.\(^2\)

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

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\(^2\)Induction Program as described here borrows from three programs running earlier at different institutions: (1) Foundation Program running at IIT Gandhinagar since July 2011, (2) Human Values course running at IIIT Hyderabad since July 2005, and (3) Counselling Service or mentorship running at several IITs for many decades. Contribution of each one is described next.

IIT Gandhinagar was the first IIT to recognize and implement a special 5-week Foundation Program for the incoming 1st year UG students. It took a bold step that the normal classes would start only after the five week period. It involved activities such as games, art, etc., and also science and other creative workshops and lectures by resource persons from outside.

IIIT Hyderabad was the first one to implement a compulsory course on Human Values. Under it, classes were held by faculty through discussions in small groups of students, rather than in lecture mode. Moreover, faculty from all departments got involved in conducting the group discussions under the course. The content is non-sectarian, and the mode is dialogical rather than sermonising or lecturing. Faculty were trained beforehand, to conduct these discussions and to guide students on issues of life.

Counselling at some of the IITs involves setting up mentor-mentee network under which 1st year students would be divided into small groups, each assigned a senior student as a student guide, and a faculty member as a mentor. Thus, a new student gets connected to a faculty member as well as a senior student, to whom he/she could go to in case of any difficulty whether psychological, financial, academic, or otherwise.

The Induction Program defined here amalgamates all the three into an integrated whole, which leads to its high effectiveness in terms of building physical activity, creativity, bonding, and character. It develops sensitivity towards self and one’s relationships, builds awareness about others and society beyond the individual, and also in bonding with their own batch-mates and a senior student besides a faculty member.

Scaling up the above amalgamation to an intake batch of 1000 plus students was done at IIT(BHU), Varanasi starting from July 2016.
2.1. Physical Activity
This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.

2.2. Creative Arts
Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

2.3. Universal Human Values
It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base.

Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values.

The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT(BHU) are noteworthy and one can learn from them.3

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program.

Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

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3The Universal Human Values Course is a result of a long series of experiments at educational institutes starting from IIT-Delhi and IIT Kanpur in the 1980s and 1990s as an elective course, NIT Raipur in late 1990s as a compulsory one-week off campus program. The courses at IIT(BHU) which started from July 2014, are taken and developed from two compulsory courses at IIIT Hyderabad first introduced in July 2005.
2.4. Literary
Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

2.5. Proficiency Modules
This period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

2.6. Lectures by Eminent People
This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in public life.

2.7. Visits to Local Area
A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

2.8. Familiarization to Dept./Branch & Innovations
The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

3. Schedule
The activities during the Induction Program would have an Initial Phase, a Regular Phase and a Closing Phase. The Initial and Closing Phases would be two days each.

3.1. Initial Phase

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 0</td>
<td>Whole Day</td>
<td>Students Arrive – Hostel Allotment (Preferably do pre-allotment)</td>
</tr>
<tr>
<td>Day 1</td>
<td>09:00 AM – 03:00 PM</td>
<td>Academic Registration</td>
</tr>
<tr>
<td></td>
<td>04:30 PM – 06:00 PM</td>
<td>Orientation</td>
</tr>
<tr>
<td>Day 2</td>
<td>09:00 AM – 10:00 AM</td>
<td>Diagnostic test (for English etc.)</td>
</tr>
<tr>
<td></td>
<td>10:00 AM – 12:25 PM</td>
<td>Visit to respective depts.</td>
</tr>
<tr>
<td></td>
<td>12:30 PM – 01:55 PM</td>
<td>Lunch</td>
</tr>
<tr>
<td></td>
<td>02:00 PM – 02:55 PM</td>
<td>Director’s address</td>
</tr>
<tr>
<td></td>
<td>03:00 PM – 03:30 PM</td>
<td>Interaction with parents</td>
</tr>
<tr>
<td></td>
<td>03:30 PM – 05:00 PM</td>
<td>Mentor-Mentee Groups - Introduction within group. (Same as Universal Human Values Group)</td>
</tr>
</tbody>
</table>

3.2. Regular Phase
3.2.1. Daily Schedule
Some of the activities are on a daily basis, while some others are at specified periods within the Induction Program. We first show a typical daily timetable.

<table>
<thead>
<tr>
<th>Session</th>
<th>Time</th>
<th>Activity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Wake up Call</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>06:00 AM</td>
<td>Physical Activity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>06:30 AM – 07:10 AM</td>
<td>Mild Exercise / Yoga</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>07:15 AM – 08:55 AM</td>
<td>Bath, Breakfast etc.</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>09:10 AM – 10:55 AM</td>
<td>Creative Arts / Universal Human Values</td>
<td>Half the groups do creative arts</td>
</tr>
<tr>
<td>III</td>
<td>11:00 AM – 12:55 PM</td>
<td>Creative Arts / Universal Human Values</td>
<td>Complementary Alternate Groups</td>
</tr>
<tr>
<td></td>
<td>01:00 PM – 02:25 PM</td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>02:30 PM – 03:55 PM</td>
<td>Afternoon Session</td>
<td>See below</td>
</tr>
<tr>
<td>V</td>
<td>04:00 PM – 05:00 PM</td>
<td>Afternoon Session</td>
<td>See below</td>
</tr>
<tr>
<td></td>
<td>05:00 PM – 05:25 PM</td>
<td>Break / Light Tea</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>05:30 PM – 06:45 PM</td>
<td>Games / Special Lectures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>06:50 PM – 08:25 PM</td>
<td>Rest and Dinner</td>
<td></td>
</tr>
<tr>
<td>VII</td>
<td>08:30 PM – 09:25 PM</td>
<td>Informal Interactions</td>
<td>(In hostels)</td>
</tr>
</tbody>
</table>

Sundays are off. Saturdays have the same schedule as above or have outings.

3.2.2. Afternoon Activities (Non-Daily)
The following five activities are scheduled at different times of the Induction Program, and are not held daily for everyone:
1. Familiarization to Dept./Branch & Innovations
2. Visits to Local Area
3. Lectures by Eminent People
4. Literary
5. Proficiency Modules

Here is the approximate activity schedule for the afternoons (may be changed to suit local needs):

<table>
<thead>
<tr>
<th>Session</th>
<th>Activity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>Familiarization with Dept./Branch &amp; Innovations</td>
<td>For 3 Days (Day 3 to Day 5)</td>
</tr>
<tr>
<td>IV, V and VI</td>
<td>Visit to Local Area</td>
<td>For 3 Days – interspersed (e.g. Saturdays)</td>
</tr>
</tbody>
</table>
### 3.3. Closing Phase

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last But One Day</td>
<td>08:30 AM – 12:00 PM</td>
<td>Discussions and finalization of presentation within each group</td>
</tr>
<tr>
<td></td>
<td>02:00 AM -05:00 PM</td>
<td>Presentation by each group in front of 4 other groups besides their own (about 100 students)</td>
</tr>
<tr>
<td>Last Day</td>
<td>Whole Day</td>
<td>Examinations (if any). May be extended to last 2 days, in case needed.</td>
</tr>
</tbody>
</table>

### 3.4. Follow Up after Closure

A question comes up as to what would be the follow up program after the formal 3-week Induction Program is over? The groups which are formed should function as mentor- mentee network. A student should feel free to approach his faculty mentor or the student guide, when facing any kind of problem, whether academic or financial or psychological etc. (For every 10 undergraduate first year students, there would be a senior student as a student guide, and for every 20 students, there would be a faculty mentor.) Such a group should remain for the entire 4-5-year duration of the stay of the student. Therefore, it would be good to have groups with the students as well as teachers from the same department/discipline.

Here we list some important suggestions which have come up and which have been experimented with:

#### 3.4.1. Follow Up after Closure – Same Semester

It is suggested that the groups meet with their faculty mentors once a month, within the semester after the 3-week Induction Program is over. This should be a scheduled meeting shown in the timetable. (The groups are of course free to meet together on their own more often, for the student groups to be invited to their faculty mentor’s home for dinner or tea, nature walk, etc.)

#### 3.4.2. Follow Up – Subsequent Semesters

It is extremely important that continuity be maintained in subsequent semesters. It is suggested that at the start of the subsequent semesters (up to fourth semester), three days be set aside for three full days of activities related to follow up to Induction Program. The students be shown inspiring films, do collective art work, and group discussions be conducted. Subsequently, the groups should meet at least once a month.
4. Summary
Engineering institutions were set up to generate well trained manpower in engineering with a feeling of responsibility towards oneself, one’s family, and society. The incoming undergraduate students are driven by their parents and society to join engineering without understanding their own interests and talents. As a result, most students fail to link up with the goals of their own institution.

The graduating student must have values as a human being, and knowledge and meta-skills related to his/her profession as an engineer and as a citizen. Most students who get demotivated to study engineering or their branch, also lose interest in learning.

The Induction Program is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character.

The Universal Human Values component, which acts as an anchor, develops awareness and sensitivity, feeling of equality, compassion and oneness, draw attention to society and nature, and character to follow through. It also makes them reflect on their relationship with their families and extended family in the college (with hostel staff and others). It also connects students with each other and with teachers so that they can share any difficulty they might be facing and seek help.

References:
31 March 2016, IIT Directors’ Secretariat, IIT Delhi.

Contact: Prof. Rajeev Sangal, Director, IIT(BHU), Varanasi (director@iitbhu.ac.in).

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