

17.	Construct a tree from given in order and preorder traversal.
18.	Implement Dijkstra's Algorithm.
19.	Implement Circular Linked List with various operations.
20.	Represent graph using adjacency list or matrix and generate minimum spanning tree using Prim's algorithm.

### Group Assignment

- Make Group of **4 students** in a batch (Batch of 20)
- Group will select any one topic as group assignment
- After completing the assignment, the respective group will present it during the practical slot.
  - Distribution of work in a group during presentation may contain:
    - Algorithm / Flowchart
    - Program Explanation
    - Applications

### Virtual LAB Links:

1. **Data Structures - I:**  
<https://ds1-iiith.vlabs.ac.in/data-structures-1/>
2. **Data Structures - II:**  
<https://ds2-iiith.vlabs.ac.in/data-structures-2/>
3. **Data Structures Lab:**  
<http://cse01-iiith.vlabs.ac.in/>
4. **Computer Programming Lab:**  
<http://cse02-iiith.vlabs.ac.in/>

**Note:** Additional (min.2) practicals are to be performed using Virtual Lab.

<b>Savitribai Phule Pune University</b>		
<b>Second Year of Electronics / E &amp; Tc Engineering (2019 Course)</b>		
<b>204189: Electronic Skill Development Lab</b>		
<b>Teaching Scheme:</b>	<b>Credit</b>	<b>Examination Scheme:</b>
<b>Practical: 02 hrs. / week</b>	<b>01</b>	<b>Term Work: 25 Marks</b>
<b>Prerequisite Courses, if any:</b> Basic Electronics Engineering, Fundamentals of Programming, Open-source electronics platform based on easy-to-use hardware and software (preferably Arduino)		
<b>Companion Course, if any:</b> Any one of the following:		
<ol style="list-style-type: none"> <li>1. Jeremy Blum PCB tutorials.</li> <li>2. OrCAD basic Tutorials.</li> </ol>		



<b>List of Assignments [Min. 10 has to be completed]</b>	
<b>Group A: Application of Electronics Principles in Practice</b>	
1.	Electronic Components and Connections (Bread boarding).
2.	Introduction and applications using Arduino and micro python.
3.	Using Sensors & Actuators and their interfacing with Arduino (Motor Driver with relays , Reversible motor, SSR).
4.	Wireless Connectivity to Arduino .
<b>Group B: Hardware Design, Fault Finding, Testing, Repair and Measuring</b>	
5.	Drawing layout of PCB using PCB design software.
6.	Single layer PCB design for a simple electronic circuit.
7.	Using test equipment for testing, fault finding & repair etc.
8.	Use of measuring equipment for measurement of signals.
9.	Using Simulation software for design & testing of electronic circuits.
<b>Group C: Assembly, SMD Overview, Power Budgeting, Batteries (Lead Acid , LiPo), Solar</b>	
10.	Assemble and utilize mechanical parts such as DC Motor, AC Motor, Stepper motor Solenoid, sensors etc., connect and assemble mechanical parts to form a working unit , Wire and form cables. industry standards
11.	Assemble and use various types of parts and surface mounted devise parts, Assemble parts to standard determined by IPC-A-610, Work to correct sequences and tolerances, Accurately solder components using lead free solder to comply with
12.	Calculation of Power budget for an electronic circuit.
13.	Study & Use of various types of Batteries.
14.	Study of various solar power generation systems.

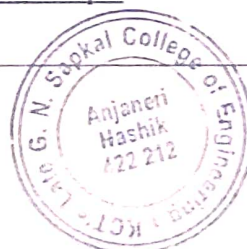
### Learning Resources

#### Reference Books:

1. R S Khandpur, "Printed Circuit Boards: Design - Fabrication and Assembly", Tata McGraw Hill
2. Simon Monk "Hacking Electronics", McGraw Hill

#### Web resources:

1. <https://github.com/arduino/Arduino>
2. [https://spoken-tutorial.org/tutorialsearch/?search\\_foss=Arduino&search\\_language=English](https://spoken-tutorial.org/tutorialsearch/?search_foss=Arduino&search_language=English)
3. <https://worldskillsindia.co.in/worldskill/file/2019/Electronics.pdf>
4. <https://worldskills.org/what/projects/wsss/>



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<b>Reference Books:</b>	
1. R S Khandpur, "Printed Circuit Boards: Design - Fabrication and Assembly", Tata McGraw Hill	
2. Simon Monk "Hacking Electronics", McGraw Hill	
<b>Web resources:</b>	
1. <a href="https://github.com/arduino/Arduino">https://github.com/arduino/Arduino</a>	
2. <a href="https://spoken-tutorial.org/tutorialsearch/?search_foss=Arduino&amp;search_language=English">https://spoken-tutorial.org/tutorialsearch/?search_foss=Arduino&amp;search_language=English</a>	
3. <a href="https://worldskillsindia.co.in/worldskill/file/2019/Electronics.pdf">https://worldskillsindia.co.in/worldskill/file/2019/Electronics.pdf</a>	
4. <a href="https://worldskills.org/what/projects/wsss/">https://worldskills.org/what/projects/wsss/</a>	



<b>Savitribai Phule Pune University</b> <b>Second Year of Electronics / E &amp; Tc Engineering (2019 Course)</b> <b>204190: Mandatory Audit Course - 3</b>		
<b>Teaching Scheme:</b>	<b>Credit</b>	<b>Examination Scheme:</b>
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**List of Courses to be opted (Any one) under Mandatory Audit Course 3**

- Technical English For Engineers
- Ecology and Environment
- Ecology and Society
- German I
- Science, Technology and Society
- Introduction to Japanese Language and Culture

**GUIDELINES FOR CONDUCTION OF AUDIT COURSE**

In addition to credits courses, it is mandatory that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for two of the audit courses (One in each semester). Such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.



### **Selecting an Audit Course:**

### **Using NPTEL Platform:**

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website [www.nptel.ac.in](http://www.nptel.ac.in)

- Student can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with certificate.

### **Assessment of an Audit Course:**

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of same students can submit as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as "Present" and the student will be awarded the grade AP on the marksheet.



Savitribai Phule Pune University		
Second Year of Electronics / E & Tc Engineering (2019 Course)		
204199: Employability Skills Development		
Teaching Scheme:	Credit	Examination Scheme:
Theory: 02 hrs. / week Practical: 02 hrs. / week	02 + 01 = 03	Term work: 50 Marks
Prerequisite Courses, if any: --		
Companion Course, if any: --		
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Develop good communication skills – both oral as well as written.</li> <li>• Encourage creative and critical thinking among students.</li> <li>• Nurture collaborative behavior to work efficiently in groups.</li> </ul>		
<b>Course Outcomes:</b> On completion of the course, learner will be able to - <p>CO1: Define personal and career goals using introspective skills and SWOC assessment. Outline and evaluate short-term and long-term goals.</p> <p>CO2: Develop effective communication skills (listening, reading, writing, and speaking), self- management attributes, problem solving abilities and team working &amp; building capabilities in order to fetch employment opportunities and further succeed in the workplace.</p> <p>CO3: Be a part of a multi-cultural professional environment and work effectively by enhancing inter-personal relationships, conflict management and leadership skills.</p> <p>CO4: Comprehend the importance of professional ethics, etiquettes &amp; morals and demonstrate sensitivity towards it throughout certified career.</p> <p>CO5: Develop practically deployable skill set involving critical thinking, effective presentations and leadership qualities to hone the opportunities of employability and excel in the professional environment.</p>		
Course Contents		
Unit I	Understanding Self and Soft Skills	(04 Hrs)
Introduction to introspective methods, SWOC Analysis, Understanding the importance of soft skills, soft skill vs hard skill, interdisciplinary relevance, emotional quotient and emotional intelligence, personal and career goal setting, aligning aspirations with individual's skill sets, understanding self-esteem and critically evaluating oneself.		



Mapping of Course Outcomes for Unit I	CO1: Define personal and career goals using introspective skills and SWOC assessment. Outline and Evaluate short-term and long-term goals.	
Unit II	Communication Skills	(04 Hrs)
Essentiality of good communication skills, Importance of feedback, Different types of communication, Barriers in communication and how to overcome these barriers, Significance of non-verbal messages as augmentation to verbal communication, Group Discussion, Listening Vs Hearing, Reading to comprehend, Learning to skim and scan to extract relevant information, Effective digital communication.		
Mapping of Course Outcomes for Unit II	CO2: Develop effective communication skills (listening, reading, writing, and speaking), self - management attributes, problem solving abilities and team working & building capabilities in order to fetch employment opportunities and further succeed in the workplace.	
Unit III	Language & Writing Skills	(04 Hrs)
Fundamentals of English Grammar, improve Lexical resource, essential steps to improve spoken and written English, Business vocabulary, Writing - Email, Resume, Formal letter, Official Communication, Essay, Presentation – Planning, Organizing, Preparing and Delivering Professional presentation, Resume writing: Resume content, identification of carrier objective, characteristics of good resume, different formats of resume-chronological, Functional , Hybrid Effective letter and cover letter writing, Application writing, Report writing.		
Mapping of Course Outcomes for Unit III	CO2: Develop effective communication skills (listening, reading, writing, and speaking), self - management attributes, problem solving abilities and team working & building capabilities in order to fetch employment opportunities and further succeed in the workplace.	
Unit IV	Leadership Skills and Group Dynamics	(04 Hrs)
Understanding Corporate Culture and Leadership skills, difference between a leader and a manager, Importance of resilience in a professional surrounding, Developing empathy and emotional intelligence, being assertive and confident, 4-Ds of decision making, Creative and solution-centric thinking, Resolving conflicts, Working cohesively as a team to achieve success, 5 Qualities of an Effective team - Positivity, respect for others, trust, goal-focused, supportiveness.		
Mapping of Course Outcomes for Unit IV	CO3: Be a part of a multi-cultural professional environment and work effectively by enhancing inter- personal relationships, conflict management and leadership skills.	



<b>Unit V</b>	<b>Professionalism &amp; Ethics</b>	<b>(04 Hrs)</b>
<p>Understanding ethics and morals, Importance of Professional Ethics, hindrances due to absence of Work ethics, Professional etiquette – Introductions, with colleagues, attire, events, dinning, telephone, travelling, netiquette, social media, writing.</p> <p>Stress as integral part of life, Identifying signs and sources of stress, Steps to cope with stress – open communication, positive thinking, Belief in oneself, ability to handle failure, Retrospective thinking for future learning. Organizing skills to enhance time management, Focusing on goals, smart work vs hard work, Prioritizing activities, Perils of procrastination, Daily evaluation of “to-do” list.</p>		
<b>Mapping of Course Outcomes for Unit V</b>	<p><b>CO4: Comprehend the importance of professional ethics, etiquettes &amp; morals and demonstrate sensitivity towards it throughout certified career.</b></p> <p><b>CO5: Develop practically deployable skill set involving critical thinking, effective presentations and leadership qualities to hone the opportunities of employability and excel in the professional environment.</b></p>	
<b>Unit VI</b>	<b>Quantitative Ability &amp; Logical Reasoning</b>	<b>(04 Hrs)</b>
<p>Numbers, HCF and LCM, Time and distance, Time and work, Clock, Simple interest and compound interest, Boats and steams, Number series, Ratio and proportion, probability, profit and loss, odd man out series, permutations, height and distance, square and cube root matching, selection, verbal reasoning, logical games, logical deductions, logical problems, cause and effect.</p>		
<b>Mapping of Course Outcomes for Unit VI</b>	<p><b>CO2: Develop effective communication skills (listening, reading, writing, and speaking), self - management attributes, problem solving abilities and team working &amp; building capabilities in order to fetch employment opportunities and further succeed in the workplace.</b></p>	
<b>Learning Resources</b>		
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. R. S. Agarwal “Quantitative Aptitude for Competitive Examinations” S. Chand Publications.</li> <li>2. R.Gajendra Singh Chauhan and Sangeeta Sharma, “Soft Skills-An integrated approach to maximize personality”, Wiley Publication, ISBN: 987-81-265-5639-7</li> </ol>		
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Indrajit Bhattacharya, “An Approach to Communication Skills”, Dhanpat Rai.</li> <li>2. Simon Sweeney, “English for Business Communication”, Cambridge University Press.</li> <li>3. Sanjay Kumar and Pushpa Lata, “Communication Skills”, Oxford University Press.</li> <li>4. Atkinson and Hilgard's, “Introduction to Psychology”, 14<sup>th</sup> Edition.</li> <li>5. Kenneth G. Mcgee, “Heads Up: How to Anticipate Business Surprises &amp; Seize Opportunities First”, Harvard Business School Press, Boston, Massachusetts.</li> <li>6. Krishnaswami, N. and Sriraman, “Creative English for Communication”, Macmillan.</li> </ol>		





**MOOC / NPTEL Courses:****1. NPTEL Course “Developing Soft skills & Personality”**

<https://nptel.ac.in/courses/109/104/109104107/>

**2. NPTEL Course “Communication Skills”**

<https://nptel.ac.in/courses/109/104/109104030/>

**3. NPTEL Course “Effective Writing”**

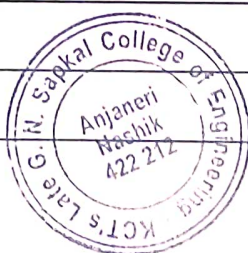
<https://nptel.ac.in/courses/109/107/109107172/>

**4. NPTEL Course “Interpersonal Skills”**

<https://nptel.ac.in/courses/109/107/109107155/>

**THEORY SESSIONS**

Sr. No.	Topic to be covered	No. of Hours
1.	Soft Skills Vs Hard Skills	1
2.	Planning Career Goals – Short Term & Long Term	1
3.	Understanding SWOC Analysis	1
4.	Resume Writing	1
5.	Presentation Skills	1
6.	Interview Skills	1
7.	Writing Skills	1
8.	Corporate Business Etiquette	2
9.	Time & Stress Management	1
10.	Attitude	1
11.	Leadership Skills	1
12.	Creative & Lateral Thinking	1
13.	Problem Solving	1
14.	Team Dynamics	1
15.	Mental Arithmetic	2



16.	Number Sequence	2
17.	Speed Calculation	2
18.	Fundamentals of English Grammar	2
19.	Verbal Reasoning / Verbal Ability	1
<b>TOTAL HOURS</b>		<b>24</b>

#### **Guidelines for Conduction of Employability Skills Development Lab**

- The teacher may design specific assignments that can highlight the learning outcomes of each unit.
- Each activity conducted in the lab should begin with a brief introduction of the topic, purpose of the activity from a professional point of view and end with the learning outcomes as feedback from students.
- Most of the lab sessions can be designed to be inclusive; allowing students to learn skills experientially; which will benefit them in the professional environment.
- Every student must be given sufficient opportunity to participate in each activity and constructive feedback from the instructor / facilitator at the end of the activity should learn towards encouraging students to work on improving their skills.
- Activities should be designed to respect cultural, emotional and social standing of students. Some of the activities can be designed to cater to enhancement of multiple skills – For eg – Team Building Activity can highlight ‘open communication’, ‘group discussion’, ‘respecting perspectives’, ‘leadership skills’, ‘focus on goals’ which can help students improve their inherent interpersonal skills.

#### **Guidelines for Student’s Lab Journal and TW Assessment**

- Each student should have a Lab Workbook (sample can be provided if required) which outlines each lab activity conducted.
- The student must respond by writing out their learning outcomes and elaborating the activities performed in the lab.
- Continuous assessment of laboratory work is to be done based on overall performance and lab assignments and performance of student.
- Each lab assignment assessment will be assigned grade/marks based on parameters with

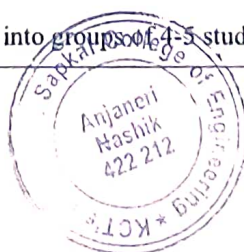


appropriate weightage.

- Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, punctuality, neatness, enthusiasm, participation and contribution in various activities-SWOC analysis, presentations, team activity, event management, group discussion, group exercises and interpersonal skills and similar other activities/assignments

### List of Laboratory Sessions

1.	<b>Introduction of Self / SWOC Analysis:</b>  a. Explain how to introduce oneself in a professional manner and presenting oneself positively. Name   Academic Profile   Achievements   Career Aspirations   Personal Information (hobbies, family, social)  b. Focus on introspection and become aware of one's Strengths, Weakness, Opportunities and Challenges.  Students can write down their SWOC in a matrix and the teacher can discuss the gist personally.
2.	<b>Career Goals and Planning:</b>  • Make students understand the difference between a job and a career. Elaborate steps on how to plan a career. ➤ Students can choose a career and they should write down what skills, knowledge, steps are need to be successful in that particular career and how they can get the right opportunity.  • Explain to students how to plan short term and long term goals. ➤ Think and write down their short term goals and long terms goals. Teacher can read and discuss (provide basic counselling) about the choices written.
3.	<b>Group Discussion:</b>  • The class can be divided into groups of 8 - 10 students in each group for a discussion lasting 10 minutes: ➤ Topics can be topical and non-controversial. After each group finishes its discussion, the teacher can give critical feedback including areas of improvement. The teacher should act as a moderator / observer only.
4.	<b>Team Building Activities:</b>  • The class can be divided into groups of 4-5 students in each group and an activity can



	<p>be given to each group:</p> <ul style="list-style-type: none"> <li>➤ The activities chosen for each team should be competitive and should involve every student in the team. The activities can be conducted indoors or outdoors depending on infrastructure.</li> </ul>
5.	<p><b>Public Speaking - (Choose any 2):</b></p> <ul style="list-style-type: none"> <li>• <b>Prepared Speech:</b> <ul style="list-style-type: none"> <li>➤ Topics are shared with students and they will be given 10 minutes to prepare and 3 minutes to deliver followed by Q&amp;A from audience. Teacher can evaluate each student based on content, communication skills, logical and cohesive presentation of topic, perspective of student, ability to handle questions and respond positively.</li> </ul> </li> <li>• <b>Extempore Speech:</b> <ul style="list-style-type: none"> <li>➤ Various topics are laid out in front of the audience and each student is to pick one topic and speak about the topic for 5 minutes followed by Q&amp;A from audience. Teacher can evaluate each student based on ability to think on his/her feet, content, communication skills, logical and cohesive presentation of topic, perspective of student, ability to handle questions and respond positively.</li> </ul> </li> <li>• <b>Reviewing an Editorial article:</b> <ul style="list-style-type: none"> <li>➤ Either using e-paper / printed copy, students have to select a recent editorial (that is non-controversial), read it and explain to the audience what the editor's perspective is and what the student's perspective is.</li> </ul> </li> <li>• <b>Book Review:</b> <ul style="list-style-type: none"> <li>➤ Each student will orally present to the audience his/her review of a book that he/she has recently read.</li> </ul> </li> </ul>
6.	<p><b>Mock Interviews:</b></p> <ul style="list-style-type: none"> <li>• Every student has to undergo this session and the teacher should seek the assistance of another faculty member / TPO Officer to act as interview panel. Students will be informed beforehand about the job profile that they are appearing the interview for and they have to come prepared with a printed copy of their resume, formally dressed. Questions will include technical as well as HR. Faculty can choose to give problems that students have to solve using their technical skills. Students will be graded on the basis of their technical knowledge, ability to answer questions well, presentation of self, body language and verbal skills.</li> </ul>



7.	<p><b>Listening and Reading Skills:</b></p> <ul style="list-style-type: none"> <li>• Listening Worksheets to be distributed among students <ul style="list-style-type: none"> <li>➤ Each student can be given specifically designed worksheets that contain blanks / matching / MCQs that are designed to an audio (chosen by the faculty). Students must listen to the audio (only once) and complete the worksheet as the audio plays. This will help reiterate active listening as well as deriving information (listening to information between the lines).</li> <li>➤ Reading Comprehension Worksheets to be distributed among students.</li> </ul> </li> <li>• Teacher can choose reading passages from non-technical domains, design worksheets with questions for students to answer. This will enhance students' reading skills by learning how to skim and scan for information.</li> </ul>
8.	<p><b>Writing Skills (Choose any 2):</b></p> <ul style="list-style-type: none"> <li>• <b>Letter / Email Writing:</b> <ul style="list-style-type: none"> <li>➤ After explaining to the students the highlights of effective writing, students can be asked to write (using digital platforms / paper-based) letter to an organization with the following subject matter: <ol style="list-style-type: none"> <li>i. Requesting opportunity to present his/her product.</li> <li>ii. Complaining about a faulty product / service.</li> <li>iii. Apologizing on behalf of one's team for the error that occurred.</li> <li>iv. Providing explanation for a false accusation by a client .</li> </ol> </li> </ul> </li> <li>• <b>Report Writing</b> <ul style="list-style-type: none"> <li>➤ After describing various formats to write report and explaining how to write a report, each student should be asked to write a report (digital / paper-based) on any of the following topics: <ul style="list-style-type: none"> <li>▪ Industrial visit.</li> <li>▪ Project participated in.</li> <li>▪ Business / Research Proposal.</li> </ul> </li> </ul> </li> <li>• <b>Resume Writing</b> <ul style="list-style-type: none"> <li>➤ The teacher should conduct a brief session outlining the importance of a CV / Resume and students can write / type out their own resumes: <ul style="list-style-type: none"> <li>▪ Share various professional formats.</li> <li>▪ Focus on highlighting individual strengths.</li> <li>▪ Develop personalized professional goals / statement at the beginning of the resume.</li> </ul> </li> </ul> </li> </ul>



9.	<p><b>Lateral and Creative Thinking:</b></p> <ul style="list-style-type: none"> <li>• Every student needs to step out of the linear thinking and develop lateral and creative thinking. Teacher can develop creative activities in the classroom / lab that will help students enhance their creative thinking. Some of the suggested activities: <ul style="list-style-type: none"> <li>➤ Each group (3-4 students) can be given random unrelated items and they will be given 20 mins to come up with creative ideas on how the objects can be used for activities / purposes other than its intended one.</li> <li>➤ Each student is given a random line and he/she has to spin a fictional story and tell it to the class (3 minutes). Each story should have a beginning, middle and end.</li> <li>➤ Each group (3-4 students) can be given a fictional / hypothetical dangerous situation and they have to find a solution to that problem. They can present it to the other teams who will then get the opportunity to pick flaws in the ideas.</li> </ul> </li> </ul>
10.	<p><b>Presentation Skills:</b></p> <p>Every student will have to choose a topic of his/her choice and make a 5-minute presentation using audio-video aids / PPT. The topic can either be technical or non-technical. Focus and evaluation of each presentation should be the depth of knowledge about the topic, originality of perspective on the topic, well-researched or not, verbal and non-verbal skills and ability to answer questions effectively. Plagiarism should be discredit and students should be warned about it.</p>
11.	<p><b>Expert Lecture:</b></p> <p>Highlighting the need to manage stress and time, experts from the fields of health and fitness, counselling, training, medical or corporate HR can be invited to deliver a participatory session that focus on helping students to cope with parental, social, peer and career pressures.</p>
<p><b>Virtual LAB Link:</b></p> <p><b>1. Virtual English Communication Lab:</b>  <a href="https://ve-iitg.vlabs.ac.in/">https://ve-iitg.vlabs.ac.in/</a></p>	

**Note:** Additional (min.3) tutorials are to be performed using Virtual Lab.



Savitribai Phule Pune University		
Third Year of E & Tc Engineering (2019 Course)		
304193: Project Management		
Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks
Prerequisite Courses, if any: NIL		
Companion Course, if any: NIL		
<p><b>Course Objectives:</b> To make the students understand</p> <ul style="list-style-type: none"> <li>• The basics of project management and its life cycle</li> <li>• The process of project identification, selection criteria of the project and how the project planning is undertaken.</li> <li>• The organizational structure within a project and issues related to project management</li> <li>• The techniques for effective project scheduling and resource considerations in project.</li> <li>• The basics of effective handling the risks as well as managing finances within the project</li> <li>• The complete product development process and requirements for entrepreneurship along with related legal issues.</li> </ul>		
<p><b>Course Outcomes:</b> On completion of the course, learner will be able to -</p> <p><b>CO1:</b> Apply the fundamental knowledge of project management for effectively handling the projects.</p> <p><b>CO2:</b> Identify and select the appropriate project based on feasibility study and undertake its effective planning.</p> <p><b>CO3:</b> Assimilate effectively within the organizational structure of project and handle project management related issues in an efficient manner.</p> <p><b>CO4:</b> Apply the project scheduling techniques to create a Project Schedule Plan and accordingly utilize the resources to meet the project deadline.</p> <p><b>CO5:</b> Identify and assess the project risks and manage finances in line with Project Financial Management Process.</p> <p><b>CO6:</b> Develop new products assessing their commercial viability and develop skillsets for becoming successful entrepreneurs while being fully aware of the legal issues related to Product development and Entrepreneurship.</p>		



<b>Course Contents</b>		
<b>Unit I</b>	<b>Fundamentals of Project Management</b>	<b>(06 Hrs.)</b>
<b>Basics of Project Management:</b> Definition of Project, The Project Life Cycle, Definition of project management, Need of Project management, Project Management process and its importance, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles.		
Mapping of Course Outcomes for Unit I	CO1: Apply the fundamental knowledge of project management for effectively handling the projects.	
<b>Unit II</b>	<b>Project Identification, Selection &amp; Planning</b>	<b>(06 Hrs.)</b>
<b>Project Identification and Selection:</b> Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point.		
<b>Project Planning:</b> Introduction and need for Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS)		
Mapping of Course Outcomes for Unit II	CO2: Identify and select the appropriate project based on feasibility study and undertake its effective planning.	
<b>Unit III</b>	<b>Project Organizational structure &amp; Issues</b>	<b>(07 Hrs.)</b>
<b>Organizational Structure and Organizational Issues:</b> Introduction, Concept of Organizational Structure, Roles and Responsibilities of Project Leader, Relationship between Project Manager and Line Manager, Leadership Styles for Project Managers, Conflict Resolution, Team Management and Diversity Management, Change management		
Mapping of Course Outcomes for Unit III	CO3: Assimilate effectively within the organizational structure of project and handle project management related issues in an efficient manner.	
<b>Unit IV</b>	<b>Project Scheduling</b>	<b>(07 Hrs.)</b>
<b>PERT and CPM:</b> Introduction, Development of Project Network, Time Estimation, Determination of the Critical Path, PERT Model, Measures of variability, CPM Model, Network Cost System		
<b>Resources Considerations in Projects:</b> Introduction, Resource Allocation, Scheduling, Project Cost Estimate and Budgets, Cost Forecasts		
Mapping of Course Outcomes for Unit IV	CO4: Apply the project scheduling techniques to create a Project Schedule plan and accordingly utilize the resources to meet the project deadline.	



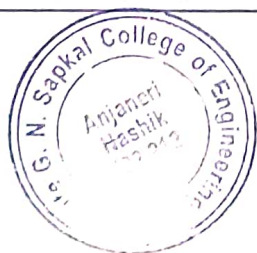


Unit V	Project Risk & Financial Management	(08 Hrs.)
<p><b>Project Risk Management:</b> Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks</p> <p><b>Introduction to Project Management Tools</b> such as: Trello, JIRA and Asana.</p> <p><b>Financial Management in Projects:</b> Project Finance structure, Process of Project Financial Management: Conducting Feasibility Studies, Planning the Project Finance, Arranging the Financial Package, Controlling the Financial Package, Controlling Financial Risk, Options Models.</p>		
Mapping of Course Outcomes for Unit V	CO5: Identify and assess the project risks and manage finances in line with Project Financial Management Process.	
Unit VI	Product Development & Entrepreneurship	(08 Hrs.)
<p><b>Product Development:</b> Introduction, Development Process and organizations, product planning, identifying customer needs, Product Significations, concept generation, selection, testing, Design for Manufacturing, Prototyping, Robust Design</p> <p><b>Entrepreneurship:</b> Concept, knowledge, and skills requirement; characteristic of successful entrepreneurs; entrepreneurship process; factors impacting emergence of entrepreneurship</p> <p><b>Legal issues related to Product development and Entrepreneurship:</b> Intellectual property rights- patents, trademarks, copyrights, trade secrets, licensing, franchising.</p>		
Mapping of Course Outcomes for Unit VI	CO6: Develop new products assessing their commercial viability and develop skillsets for becoming successful entrepreneurs while being fully aware of the legal issues related to Product development and Entrepreneurship.	

### Learning Resources

#### Text Books:

1. H.Kerzer, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", John Wiley & Sons, Inc., 10<sup>th</sup> Edition, 2009.
2. Chandra, P., "Projects", Tata McGraw-Hill Education, 8<sup>th</sup> Edition, 2009.



### Reference Books:

1. Morris, P. W. G. and Pinto, J. K., "The Wiley Guide to Managing Projects", JohnWiley & Sons, 2004.
2. Karl Ulrich, Steven Eppinger, "Product Design and Development", McGraw Hill / Irvin, 3<sup>rd</sup> Edition 2009.
3. R. Majumdar, "Product Management in India", PHI, 2<sup>nd</sup> Edition, 2010.
4. G.S. Batra, "Development of Entrepreneurship", Deep and Deep publications, New Delhi.
5. Christine Petersen, "The Practical Guide to Project Management", PMP, 1<sup>st</sup> Edition, 2013.
6. Russell W. Darnall, John M. Preston, "Project Management from Simple to Complex", The Saylor Foundation.
7. Levy, F. K. and Wiest, J. D., "A Management Guide to PERT/CPM", Prentice Hall, 2<sup>nd</sup> Edition, 1969.
8. Lewis, R., "Project Management: Strategic Design and Implementation", McGraw-Hill, 5<sup>th</sup> Edition. 2006.
9. Venkataraman. R., J.K. Pinto, "Cost and Value Management in Projects", John Wiley & sons.

### MOOC / NPTEL Courses:

#### 1. NPTEL Course "Project Management for Managers"

Link of the Course: <https://nptel.ac.in/courses/110/107/110107081/>

#### 2. NPTEL Course on "Intellectual Property Rights and Competition Law"

Link of the Course: <https://nptel.ac.in/courses/110/105/110105139/>

### List of Tutorials to be carried out

1.	Understanding Impact of Delays in Project Completions with a company's case study.
2.	Designing a Work Breakdown Structure (WBS) for any sample project.
3.	Case study on Conflict Resolution and understanding its challenges.
4.	Solve examples on Project scheduling using CPM and PERT Model.
5.	Assignment on Risk Identification and Risk Analysis with a company's example and/ or exploration of various project management tools.
6.	Prepare a Business plan for an sample Product/ Service to be launched.



**Savitribai Phule Pune University**  
**Third Year of E & Tc Engineering (2019 Course)**  
**304194: Power Devices & Circuits**

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

**Prerequisite Courses, if any:**

1. Basic Electrical Engineering
2. Basic Electronics Engineering
3. Electronic Circuits
4. Electrical Circuits

**Companion Course, if any:** Power Devices & Circuits Lab

**Course Objectives:**

- To introduce different power devices viz. SCR, GTO, MOSFET and IGBT with construction, characteristics, repetitive and non repetitive ratings and typical triggering/driver circuits.
- To understand working, design and performance analysis and applications of various power converter circuits such as ac to dc converters, inverter and chopper
- To know various protection circuit requirements of power electronic devices.

**Course Outcomes:** On completion of the course, learner will be able -

- CO1:** To differentiate based on the characteristic parameters among SCR, GTO, MOSFET & IGBT and identify suitability of the power device for certain applications and understand the significance of device ratings.
- CO2:** To design triggering / driver circuits for various power devices.
- CO3:** To evaluate and analyze various performance parameters of the different converters and its topologies.
- CO4:** To understand significance and design of various protections circuits for power devices.
- CO5:** To evaluate the performance of uninterruptible power supplies, switch mode power supplies and battery.
- CO6:** To understand case studies of power electronics in applications like electric vehicles, solar systems etc.



<b>Course Contents</b>		
<b>Unit I</b>	<b>Study of Power Devices</b>	<b>(06 Hrs.)</b>
Construction, VI characteristics (input, output and transfer if any), switching characteristics of SCR, GTO, Power MOSFET and IGBT, Performance overview of Silicon, Silicon Carbide & GaN based MOSFET and IGBT, various repetitive and non-repetitive ratings of SCR, GTO, Power MOSFET & IGBT and their significance, requirement of a typical triggering / driver (such as opto isolator) circuits for various power devices, importance of series and parallel operations of various power devices ( <b>no derivation and numerical</b> ).		
Mapping of Course Outcomes for Unit I	CO1: To differentiate based on the characteristic parameters among SCR, GTO, MOSFET & IGBT and identify suitability of the power device for certain applications and understand the significance of device ratings.  CO2: To design triggering / driver circuits for various power devices	
<b>Unit II</b>	<b>AC to DC Power Converters</b>	<b>(06 Hrs.)</b>
Concept of line & forced commutation, Single phase Semi & Full converters using SCR for R and R-L loads and its performance analysis and numerical, Effect of source inductance, Significance of power factor and its improvement using PWM based techniques, Three phase Full converters using SCR for R load and its performance analysis, Single Phase PWM Rectifier using IGBT, Three Phase Controlled Rectifier Using IGBT, Difference between SCR based conventional rectifiers and IGBT based rectifiers.		
Mapping of Course Outcomes for Unit II	CO3: To evaluate and analyze various performance parameters of the different converters and its topologies.	
<b>Unit III</b>	<b>DC to AC Converters</b>	<b>(06 Hrs.)</b>
Single phase half and full bridge square wave inverter for R and R-L load using MOSFET / IGBT and its performance analysis and numerical, Cross conduction in inverter, need of voltage control and strategies in inverters, classifications of voltage control techniques, control of voltage using various PWM techniques and their advantages, concept and need of harmonic elimination / reduction in inverters, Three Phase voltage source inverter for balanced star R load with 120 and 180 degree mode of operation, device utilization factor, Advanced Converters like matrix inverter, multi-level inverters and their topologies and its driver circuits (no derivation and numerical).		
Mapping of Course Outcomes for Unit III	CO3: To evaluate and analyze various performance parameters of the different converters and its topologies.	
<b>Unit IV</b>	<b>DC to DC Converters</b>	<b>(06 Hrs.)</b>
Classification of choppers, Step down chopper for R and RL load and its performance analysis, Step up chopper, various control strategies for choppers, types of choppers (isolated and non isolated) such as type A, B, C, D & E, switch mode power supply (SMPS) viz buck, boost and buck-boost, Fly back, Half and full Bridge isolated and non-isolated interleaved bidirectional topologies, and concept of integrated converter and design of LM3524 based choppers, concept of maximum power point tracking (MPPT).		
Mapping of Course Outcomes for Unit IV	CO3: To evaluate and analyze various performance parameters of the different converters and its topologies.	



Unit V	Power Devices Protection and Circuits	(06 Hrs.)
Over voltage, over current, di/dt and dv/dt protection circuits and their design, Various cooling techniques and heat sink design, Resonant converters such as Zero current switching (ZCS) and Zero voltage switching (ZVS), Electromagnetic interference such as radiated and conducted EMI, Difference between EMI and EMC, EMI sources and soft switching and minimizing / shielding techniques for EMI, Various EMI and EMC standards, Importance of isolation transformer.		
Mapping of Course Outcomes for Unit V	CO4: To understand significance and design of various protections circuits for power devices.	
Unit VI	Power Electronics Applications	(06 Hrs.)
AC Voltage Controller using IGBT & SCR, Fan Regulator, Electronic Ballast, LED Lamp driver, DC motor drive for single phase separately excited dc motor, BLDC motor drive, Variable voltage & variable frequency three phase induction motor drive, On-line and Off- line UPS, study of various selection criteria and performance parameters of batteries in battery operated power systems, battery charging models and modes for EVs, Architecture of EVs battery charger, PFC stage circuit topologies with details of Full-bridge boost rectifier and Full-bridge interleaved for EV battery charger, case study of power electronics in electric vehicle and photovoltaic solar system		
Mapping of Course Outcomes for Unit VI	CO5: To evaluate the performance of uninterruptible power supplies, switch mode power supplies and battery.  CO6: To understand case studies of power electronics in applications like electric vehicles, solar systems etc.	

### Learning Resources

#### Text Books:

1. M. H. Rashid, "Power Electronics Circuits Devices and Applications", PHI, 4<sup>th</sup> Edition 2017  
New Delhi.
2. M. D. Singh and K. B. Khanchandani, "Power Electronics", TMH, 2<sup>nd</sup> Edition 2006.



17.	Construct a tree from given in order and preorder traversal.
18.	Implement Dijkstra's Algorithm.
19.	Implement Circular Linked List with various operations.
20.	Represent graph using adjacency list or matrix and generate minimum spanning tree using Prim's algorithm.
<b>Group Assignment</b>	
<ul style="list-style-type: none"> <li>• Make Group of 4 students in a batch (Batch of 20)</li> <li>• Group will select any one topic as group assignment</li> <li>• After completing the assignment, the respective group will present it during the practical slot. <ul style="list-style-type: none"> <li>➤ Distribution of work in a group during presentation may contain: <ul style="list-style-type: none"> <li>▪ Algorithm / Flowchart</li> <li>▪ Program Explanation</li> <li>▪ Applications</li> </ul> </li> </ul> </li> </ul>	
<b>Virtual LAB Links:</b>	
<p><b>1. Data Structures - I:</b>  <a href="https://ds1-iiith.vlabs.ac.in/data-structures-1/">https://ds1-iiith.vlabs.ac.in/data-structures-1/</a></p> <p><b>2. Data Structures - II:</b>  <a href="https://ds2-iiith.vlabs.ac.in/data-structures-2/">https://ds2-iiith.vlabs.ac.in/data-structures-2/</a></p> <p><b>3. Data Structures Lab:</b>  <a href="http://cse01-iiith.vlabs.ac.in/">http://cse01-iiith.vlabs.ac.in/</a></p> <p><b>4. Computer Programming Lab:</b>  <a href="http://cse02-iiith.vlabs.ac.in/">http://cse02-iiith.vlabs.ac.in/</a></p>	

**Note:** Additional (min.2) practicals are to be performed using Virtual Lab.

<b>Savitribai Phule Pune University</b> <b>Second Year of Electronics / E &amp; Tc Engineering (2019 Course)</b> <b>204189: Electronic Skill Development Lab</b>		
<b>Teaching Scheme:</b>	<b>Credit</b>	<b>Examination Scheme:</b>
<b>Practical: 02 hrs. / week</b>	<b>01</b>	<b>Term Work: 25 Marks</b>
<b>Prerequisite Courses, if any:</b> Basic Electronics Engineering, Fundamentals of Programming, Open-source electronics platform based on easy-to-use hardware and software (preferably Arduino)		
<b>Companion Course, if any:</b> Any one of the following: <ol style="list-style-type: none"> <li>1. Jeremy Blum PCB tutorials.</li> <li>2. OrCAD basic Tutorials.</li> </ol>		



**List of Assignments [Min. 10 has to be completed]**

**Group A: Application of Electronics Principles in Practice**

1.	Electronic Components and Connections (Bread boarding).
2.	Introduction and applications using Arduino and micro python.
3.	Using Sensors & Actuators and their interfacing with Arduino (Motor Driver with relays , Reversible motor, SSR).
4.	Wireless Connectivity to Arduino .

**Group B: Hardware Design, Fault Finding, Testing, Repair and Measuring**

5.	Drawing layout of PCB using PCB design software.
6.	Single layer PCB design for a simple electronic circuit.
7.	Using test equipment for testing, fault finding & repair etc.
8.	Use of measuring equipment for measurement of signals.
9.	Using Simulation software for design & testing of electronic circuits.

**Group C: Assembly, SMD Overview, Power Budgeting, Batteries (Lead Acid , LiPo), Solar**

10.	Assemble and utilize mechanical parts such as DC Motor, AC Motor, Stepper motor Solenoid, sensors etc., connect and assemble mechanical parts to form a working unit , Wire and form cables. industry standards
11.	Assemble and use various types of parts and surface mounted device parts, Assemble parts to standard determined by IPC-A-610, Work to correct sequences and tolerances, Accurately solder components using lead free solder to comply with
12.	Calculation of Power budget for an electronic circuit.
13.	Study & Use of various types of Batteries.
14.	Study of various solar power generation systems.

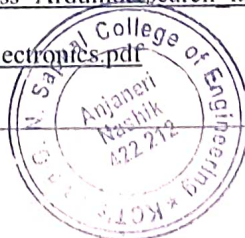
**Learning Resources**

**Reference Books:**

1. R S Khandpur, "Printed Circuit Boards: Design - Fabrication and Assembly", Tata McGraw Hill
2. Simon Monk "Hacking Electronics", McGraw Hill

**Web resources:**

1. <https://github.com/arduino/Arduino>
2. [https://spoken-tutorial.org/tutorialsearch/?search\\_foss=Arduino&search\\_language=English](https://spoken-tutorial.org/tutorialsearch/?search_foss=Arduino&search_language=English)
3. <https://worldskillsindia.co.in/worldskill/file/2019/Electronics.pdf>
4. <https://worldskills.org/what/projects/wsss/>



<b>Savitribai Phule Pune University</b>		
<b>Second Year of Electronics / E &amp; Tc Engineering (2019 Course)</b>		
<b>204190: Mandatory Audit Course - 3</b>		
<b>Teaching Scheme:</b>	<b>Credit</b>	<b>Examination Scheme:</b>
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**List of Courses to be opted (Any one) under Mandatory Audit Course 3**

- Technical English For Engineers
- Ecology and Environment
- Ecology and Society
- German I
- Science, Technology and Society
- Introduction to Japanese Language and Culture

**GUIDELINES FOR CONDUCTION OF AUDIT COURSE**

In addition to credits courses, it is mandatory that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for two of the audit courses (One in each semester). Such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.





### **Selecting an Audit Course:**

### **Using NPTEL Platform:**

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website [www.nptel.ac.in](http://www.nptel.ac.in)

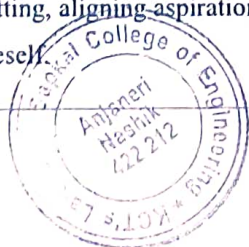
- Student can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with certificate.

### **Assessment of an Audit Course:**

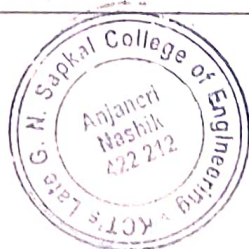
- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of same students can submit as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet.



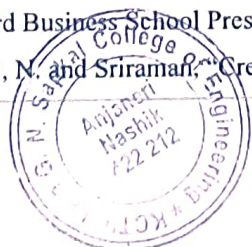
Savitribai Phule Pune University		
Second Year of Electronics / E & Tc Engineering (2019 Course)		
204199: Employability Skills Development		
Teaching Scheme:	Credit	Examination Scheme:
Theory: 02 hrs. / week	02 + 01 = 03	Term work: 50 Marks
Practical: 02 hrs. / week		
Prerequisite Courses, if any: --		
Companion Course, if any: --		
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Develop good communication skills – both oral as well as written.</li> <li>• Encourage creative and critical thinking among students.</li> <li>• Nurture collaborative behavior to work efficiently in groups.</li> </ul>		
<b>Course Outcomes:</b> On completion of the course, learner will be able to -		
CO1: Define personal and career goals using introspective skills and SWOC assessment. Outline and evaluate short-term and long-term goals.		
CO2: Develop effective communication skills (listening, reading, writing, and speaking), self- management attributes, problem solving abilities and team working & building capabilities in order to fetch employment opportunities and further succeed in the workplace.		
CO3: Be a part of a multi-cultural professional environment and work effectively by enhancing inter-personal relationships, conflict management and leadership skills.		
CO4: Comprehend the importance of professional ethics, etiquettes & morals and demonstrate sensitivity towards it throughout certified career.		
CO5: Develop practically deployable skill set involving critical thinking, effective presentations and leadership qualities to hone the opportunities of employability and excel in the professional environment.		
Course Contents		
Unit I	Understanding Self and Soft Skills	(04 Hrs)
Introduction to introspective methods, SWOC Analysis, Understanding the importance of soft skills, soft skill vs hard skill, interdisciplinary relevance, emotional quotient and emotional intelligence, personal and career goal setting, aligning aspirations with individual's skill sets, understanding self-esteem and critically evaluating oneself.		



Mapping of Course Outcomes for Unit I	CO1: Define personal and career goals using introspective skills and SWOC assessment. Outline and Evaluate short-term and long-term goals.	
Unit II	Communication Skills	(04 Hrs)
Essentiality of good communication skills, Importance of feedback, Different types of communication, Barriers in communication and how to overcome these barriers, Significance of non-verbal messages as augmentation to verbal communication, Group Discussion, Listening Vs Hearing, Reading to comprehend, Learning to skim and scan to extract relevant information, Effective digital communication.		
Mapping of Course Outcomes for Unit II	CO2: Develop effective communication skills (listening, reading, writing, and speaking), self - management attributes, problem solving abilities and team working & building capabilities in order to fetch employment opportunities and further succeed in the workplace.	
Unit III	Language & Writing Skills	(04 Hrs)
Fundamentals of English Grammar, improve Lexical resource, essential steps to improve spoken and written English, Business vocabulary, Writing - Email, Resume, Formal letter, Official Communication, Essay, Presentation – Planning, Organizing, Preparing and Delivering Professional presentation, Resume writing: Resume content, identification of carrier objective, characteristics of good resume, different formats of resume-chronological, Functional , Hybrid Effective letter and cover letter writing, Application writing, Report writing.		
Mapping of Course Outcomes for Unit III	CO2: Develop effective communication skills (listening, reading, writing, and speaking), self - management attributes, problem solving abilities and team working & building capabilities in order to fetch employment opportunities and further succeed in the workplace.	
Unit IV	Leadership Skills and Group Dynamics	(04 Hrs)
Understanding Corporate Culture and Leadership skills, difference between a leader and a manager, Importance of resilience in a professional surrounding, Developing empathy and emotional intelligence, being assertive and confident, 4-Ds of decision making, Creative and solution-centric thinking, Resolving conflicts, Working cohesively as a team to achieve success, 5 Qualities of an Effective team - Positivity, respect for others, trust, goal-focused, supportiveness.		
Mapping of Course Outcomes for Unit IV	CO3: Be a part of a multi-cultural professional environment and work effectively by enhancing inter- personal relationships, conflict management and leadership skills.	



Unit V	Professionalism & Ethics	(04 Hrs)
<p>Understanding ethics and morals, Importance of Professional Ethics, hindrances due to absence of Work ethics, Professional etiquette – Introductions, with colleagues, attire, events, dinning, telephone, travelling, netiquette, social media, writing.</p> <p>Stress as integral part of life, Identifying signs and sources of stress, Steps to cope with stress – open communication, positive thinking, Belief in oneself, ability to handle failure, Retrospective thinking for future learning. Organizing skills to enhance time management, Focusing on goals, smart work vs hard work. Prioritizing activities, Perils of procrastination, Daily evaluation of “to-do” list.</p>		
Mapping of Course Outcomes for Unit V	<p><b>CO4: Comprehend the importance of professional ethics, etiquettes &amp; morals and demonstrate sensitivity towards it throughout certified career.</b></p> <p><b>CO5: Develop practically deployable skill set involving critical thinking, effective presentations and leadership qualities to hone the opportunities of employability and excel in the professional environment.</b></p>	
Unit VI	Quantitative Ability & Logical Reasoning	(04 Hrs)
<p>Numbers, HCF and LCM, Time and distance, Time and work, Clock, Simple interest and compound interest, Boats and steams, Number series, Ratio and proportion, probability, profit and loss, odd man out series, permutations, height and distance, square and cube rootmatching, selection, verbal reasoning, logical games, logical deductions, logical problems, cause and effect.</p>		
Mapping of Course Outcomes for Unit VI	<p><b>CO2: Develop effective communication skills (listening, reading, writing, and speaking), self - management attributes, problem solving abilities and team working &amp; building capabilities in order to fetch employment opportunities and further succeed in the workplace.</b></p>	
Learning Resources		
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. R. S. Agarwal “Quantitative Aptitude for Competitive Examinations” S. Chand Publications.</li> <li>2. R.Gajendra Singh Chauhan and Sangeeta Sharma, “Soft Skills-An integrated approach to maximize personality”, Wiley Publication, ISBN: 987-81-265-5639-7</li> </ol>		
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Indrajit Bhattacharya, “An Approach to Communication Skills”, Dhanpat Rai.</li> <li>2. Simon Sweeney, “English for Business Communication”, Cambridge University Press.</li> <li>3. Sanjay Kumar and Pushpa Lata, “Communication Skills”, Oxford University Press.</li> <li>4. Atkinson and Hilgard's, “Introduction to Psychology”, 14<sup>th</sup> Edition.</li> <li>5. Kenneth G. Mcgee, “Heads Up: How to Anticipate Business Surprises &amp; Seize Opportunities First”, Harvard Business School Press, Boston, Massachusetts.</li> <li>6. Krishnaswami, N. and Sriramani, “Creative English for Communication”, Macmillan.</li> </ol>		



**MOOC / NPTEL Courses:****1. NPTEL Course “Developing Soft skills & Personality”**

<https://nptel.ac.in/courses/109/104/109104107/>

**2. NPTEL Course “Communication Skills”**

<https://nptel.ac.in/courses/109/104/109104030/>

**3. NPTEL Course “Effective Writing”**

<https://nptel.ac.in/courses/109/107/109107172/>

**4. NPTEL Course “Interpersonal Skills”**

<https://nptel.ac.in/courses/109/107/109107155/>

**THEORY SESSIONS**

Sr. No.	Topic to be covered	No. of Hours
1.	Soft Skills Vs Hard Skills	1
2.	Planning Career Goals – Short Term & Long Term	1
3.	Understanding SWOC Analysis	1
4.	Resume Writing	1
5.	Presentation Skills	1
6.	Interview Skills	1
7.	Writing Skills	1
8.	Corporate Business Etiquette	2
9.	Time & Stress Management	1
10.	Attitude	1
11.	Leadership Skills	1
12.	Creative & Lateral Thinking	1
13.	Problem Solving	1
14.	Team Dynamics	1
15.	Mental Arithmetic	2



16.	Number Sequence	2
17.	Speed Calculation	2
18.	Fundamentals of English Grammar	2
19.	Verbal Reasoning / Verbal Ability	1
<b>TOTAL HOURS</b>		<b>24</b>

**Guidelines for Conduction of Employability Skills Development Lab**

- The teacher may design specific assignments that can highlight the learning outcomes of each unit.
- Each activity conducted in the lab should begin with a brief introduction of the topic, purpose of the activity from a professional point of view and end with the learning outcomes as feedback from students.
- Most of the lab sessions can be designed to be inclusive; allowing students to learn skills experientially; which will benefit them in the professional environment.
- Every student must be given sufficient opportunity to participate in each activity and constructive feedback from the instructor / facilitator at the end of the activity should learn towards encouraging students to work on improving their skills.
- Activities should be designed to respect cultural, emotional and social standing of students. Some of the activities can be designed to cater to enhancement of multiple skills – For eg – Team Building Activity can highlight ‘open communication’, ‘group discussion’, ‘respecting perspectives’, ‘leadership skills’, ‘focus on goals’ which can help students improve their inherent interpersonal skills.

**Guidelines for Student’s Lab Journal and TW Assessment**

- Each student should have a Lab Workbook (sample can be provided if required) which outlines each lab activity conducted.
- The student must respond by writing out their learning outcomes and elaborating the activities performed in the lab.
- Continuous assessment of laboratory work is to be done based on overall performance and lab assignments and performance of student.
- Each lab assignment assessment will be assigned grade/marks based on parameters with

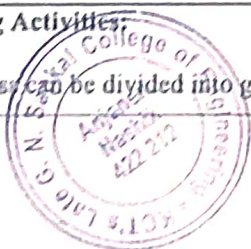


appropriate weightage.

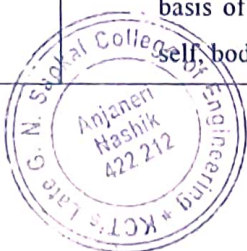
- Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, punctuality, neatness, enthusiasm, participation and contribution in various activities-SWOC analysis, presentations, team activity, event management, group discussion, group exercises and interpersonal skills and similar other activities/assignments

### List of Laboratory Sessions

1.	<p><b>Introduction of Self / SWOC Analysis:</b></p> <p>a. Explain how to introduce oneself in a professional manner and presenting oneself positively. Name   Academic Profile   Achievements   Career Aspirations   Personal Information (hobbies, family, social)</p> <p>b. Focus on introspection and become aware of one's Strengths, Weakness, Opportunities and Challenges.</p> <p>Students can write down their SWOC in a matrix and the teacher can discuss the gist personally.</p>
2.	<p><b>Career Goals and Planning:</b></p> <ul style="list-style-type: none"><li>• Make students understand the difference between a job and a career. Elaborate steps on how to plan a career.<ul style="list-style-type: none"><li>➤ Students can choose a career and they should write down what skills, knowledge, steps are need to be successful in that particular career and how they can get the right opportunity.</li></ul></li><li>• Explain to students how to plan short term and long term goals.<ul style="list-style-type: none"><li>➤ Think and write down their short term goals and long terms goals. Teacher can read and discuss (provide basic counselling) about the choices written.</li></ul></li></ul>
3.	<p><b>Group Discussion:</b></p> <ul style="list-style-type: none"><li>• The class can be divided into groups of 8 - 10 students in each group for a discussion lasting 10 minutes:<ul style="list-style-type: none"><li>➤ Topics can be topical and non-controversial. After each group finishes its discussion, the teacher can give critical feedback including areas of improvement. The teacher should act as a moderator / observer only.</li></ul></li></ul>
4.	<p><b>Team Building Activities:</b></p> <ul style="list-style-type: none"><li>• The class can be divided into groups of 4-5 students in each group and an activity can</li></ul>

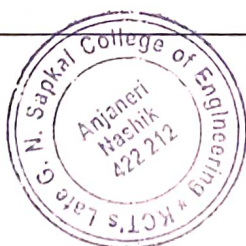


	<p>be given to each group:</p> <ul style="list-style-type: none"> <li>➤ The activities chosen for each team should be competitive and should involve every student in the team. The activities can be conducted indoors or outdoors depending on infrastructure.</li> </ul>
5.	<p><b>Public Speaking - (Choose any 2):</b></p> <ul style="list-style-type: none"> <li>• <b>Prepared Speech:</b> <ul style="list-style-type: none"> <li>➤ Topics are shared with students and they will be given 10 minutes to prepare and 3 minutes to deliver followed by Q&amp;A from audience. Teacher can evaluate each student based on content, communication skills, logical and cohesive presentation of topic, perspective of student, ability to handle questions and respond positively.</li> </ul> </li> <li>• <b>Extempore Speech:</b> <ul style="list-style-type: none"> <li>➤ Various topics are laid out in front of the audience and each student is to pick one topic and speak about the topic for 5 minutes followed by Q&amp;A from audience. Teacher can evaluate each student based on ability to think on his/her feet, content, communication skills, logical and cohesive presentation of topic, perspective of student, ability to handle questions and respond positively.</li> </ul> </li> <li>• <b>Reviewing an Editorial article:</b> <ul style="list-style-type: none"> <li>➤ Either using e-paper / printed copy, students have to select a recent editorial (that is non-controversial), read it and explain to the audience what the editor's perspective is and what the student's perspective is.</li> </ul> </li> <li>• <b>Book Review:</b> <ul style="list-style-type: none"> <li>➤ Each student will orally present to the audience his/her review of a book that he/she has recently read.</li> </ul> </li> </ul>
6.	<p><b>Mock Interviews:</b></p> <ul style="list-style-type: none"> <li>• Every student has to undergo this session and the teacher should seek the assistance of another faculty member / TPO Officer to act as interview panel. Students will be informed beforehand about the job profile that they are appearing the interview for and they have to come prepared with a printed copy of their resume, formally dressed. Questions will include technical as well as HR. Faculty can choose to give problems that students have to solve using their technical skills. Students will be graded on the basis of their technical knowledge, ability to answer questions well, presentation of self, body language and verbal skills.</li> </ul>





7.	<p><b>Listening and Reading Skills:</b></p> <ul style="list-style-type: none"> <li>• Listening Worksheets to be distributed among students <ul style="list-style-type: none"> <li>➤ Each student can be given specifically designed worksheets that contain blanks / matching / MCQs that are designed to an audio (chosen by the faculty). Students must listen to the audio (only once) and complete the worksheet as the audio plays. This will help reiterate active listening as well as deriving information (listening to information between the lines).</li> <li>➤ Reading Comprehension Worksheets to be distributed among students.</li> </ul> </li> <li>• Teacher can choose reading passages from non-technical domains, design worksheets with questions for students to answer. This will enhance students' reading skills by learning how to skim and scan for information.</li> </ul>
8.	<p><b>Writing Skills (Choose any 2):</b></p> <ul style="list-style-type: none"> <li>• <b>Letter / Email Writing:</b> <ul style="list-style-type: none"> <li>➤ After explaining to the students the highlights of effective writing, students can be asked to write (using digital platforms / paper-based) letter to an organization with the following subject matter: <ol style="list-style-type: none"> <li>i. Requesting opportunity to present his/her product.</li> <li>ii. Complaining about a faulty product / service.</li> <li>iii. Apologizing on behalf of one's team for the error that occurred.</li> <li>iv. Providing explanation for a false accusation by a client .</li> </ol> </li> </ul> </li> <li>• <b>Report Writing</b> <ul style="list-style-type: none"> <li>➤ After describing various formats to write report and explaining how to write a report, each student should be asked to write a report (digital / paper-based) on any of the following topics: <ul style="list-style-type: none"> <li>▪ Industrial visit.</li> <li>▪ Project participated in.</li> <li>▪ Business / Research Proposal.</li> </ul> </li> </ul> </li> <li>• <b>Resume Writing</b> <ul style="list-style-type: none"> <li>➤ The teacher should conduct a brief session outlining the importance of a CV / Resume and students can write / type out their own resumes: <ul style="list-style-type: none"> <li>▪ Share various professional formats.</li> <li>▪ Focus on highlighting individual strengths.</li> <li>▪ Develop personalized professional goals / statement at the beginning of the resume.</li> </ul> </li> </ul> </li> </ul>



9.	<p><b>Lateral and Creative Thinking:</b></p> <ul style="list-style-type: none"> <li>• Every student needs to step out of the linear thinking and develop lateral and creative thinking. Teacher can develop creative activities in the classroom / lab that will help students enhance their creative thinking. Some of the suggested activities: <ul style="list-style-type: none"> <li>➤ Each group (3-4 students) can be given random unrelated items and they will be given 20 mins to come up with creative ideas on how the objects can be used for activities / purposes other than its intended one.</li> <li>➤ Each student is given a random line and he/she has to spin a fictional story and tell it to the class (3 minutes). Each story should have a beginning, middle and end.</li> <li>➤ Each group (3-4 students) can be given a fictional / hypothetical dangerous situation and they have to find a solution to that problem. They can present it to the other teams who will then get the opportunity to pick flaws in the ideas.</li> </ul> </li> </ul>
10.	<p><b>Presentation Skills:</b></p> <p>Every student will have to choose a topic of his/her choice and make a 5-minute presentation using audio-video aids / PPT. The topic can either be technical or non-technical. Focus and evaluation of each presentation should be the depth of knowledge about the topic, originality of perspective on the topic, well-researched or not, verbal and non-verbal skills and ability to answer questions effectively. Plagiarism should be discredit and students should be warned about it.</p>
11.	<p><b>Expert Lecture:</b></p> <p>Highlighting the need to manage stress and time, experts from the fields of health and fitness, counselling, training, medical or corporate HR can be invited to deliver a participatory session that focus on helping students to cope with parental, social, peer and career pressures.</p>
<p><b>Virtual LAB Link:</b></p> <p><b>1. Virtual English Communication Lab:</b>  <a href="https://ve-iitg.vlabs.ac.in/">https://ve-iitg.vlabs.ac.in/</a></p>	

**Note:** Additional (min 3) tutorials are to be performed using Virtual Lab.



**Savitribai Phule Pune University**  
**Third Year of E & Tc Engineering (2019 Course)**  
**304193: Project Management**

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any: NIL

Companion Course, if any: NIL

**Course Objectives:** To make the students understand

- The basics of project management and its life cycle
- The process of project identification, selection criteria of the project and how the project planning is undertaken.
- The organizational structure within a project and issues related to project management
- The techniques for effective project scheduling and resource considerations in project.
- The basics of effective handling the risks as well as managing finances within the project
- The complete product development process and requirements for entrepreneurship along with related legal issues.

**Course Outcomes:** On completion of the course, learner will be able to -

**CO1:** Apply the fundamental knowledge of project management for effectively handling the projects.

**CO2:** Identify and select the appropriate project based on feasibility study and undertake its effective planning.

**CO3:** Assimilate effectively within the organizational structure of project and handle project management related issues in an efficient manner.

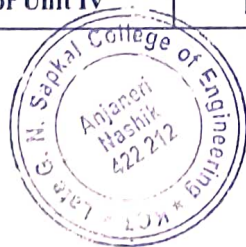
**CO4:** Apply the project scheduling techniques to create a Project Schedule Plan and accordingly utilize the resources to meet the project deadline.

**CO5:** Identify and assess the project risks and manage finances in line with Project Financial Management Process.

**CO6:** Develop new products assessing their commercial viability and develop skillsets for becoming successful entrepreneurs while being fully aware of the legal issues related to Product development and Entrepreneurship.



<b>Course Contents</b>		
<b>Unit I</b>	<b>Fundamentals of Project Management</b>	<b>(06 Hrs.)</b>
<b>Basics of Project Management:</b> Definition of Project, The Project Life Cycle, Definition of project management, Need of Project management, Project Management process and its importance, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles.		
Mapping of Course Outcomes for Unit I	CO1: Apply the fundamental knowledge of project management for effectively handling the projects.	
<b>Unit II</b>	<b>Project Identification, Selection &amp; Planning</b>	<b>(06 Hrs.)</b>
<b>Project Identification and Selection:</b> Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point.		
<b>Project Planning:</b> Introduction and need for Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS)		
Mapping of Course Outcomes for Unit II	CO2: Identify and select the appropriate project based on feasibility study and undertake its effective planning.	
<b>Unit III</b>	<b>Project Organizational structure &amp; Issues</b>	<b>(07 Hrs.)</b>
<b>Organizational Structure and Organizational Issues:</b> Introduction, Concept of Organizational Structure, Roles and Responsibilities of Project Leader, Relationship between Project Manager and Line Manager, Leadership Styles for Project Managers, Conflict Resolution, Team Management and Diversity Management, Change management		
Mapping of Course Outcomes for Unit III	CO3: Assimilate effectively within the organizational structure of project and handle project management related issues in an efficient manner.	
<b>Unit IV</b>	<b>Project Scheduling</b>	<b>(07 Hrs.)</b>
<b>PERT and CPM:</b> Introduction, Development of Project Network, Time Estimation, Determination of the Critical Path, PERT Model, Measures of variability, CPM Model, Network Cost System		
<b>Resources Considerations in Projects:</b> Introduction, Resource Allocation, Scheduling, Project Cost Estimate and Budgets, Cost Forecasts		
Mapping of Course Outcomes for Unit IV	CO4: Apply the project scheduling techniques to create a Project Schedule plan and accordingly utilize the resources to meet the project deadline.	

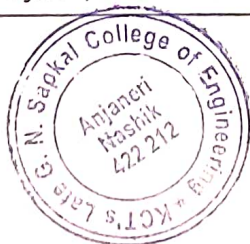


Unit V	Project Risk & Financial Management	(08 Hrs.)
<p><b>Project Risk Management:</b> Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks</p> <p><b>Introduction to Project Management Tools</b> such as: Trello, JIRA and Asana.</p> <p><b>Financial Management in Projects:</b> Project Finance structure, Process of Project Financial Management: Conducting Feasibility Studies, Planning the Project Finance, Arranging the Financial Package, Controlling the Financial Package, Controlling Financial Risk, Options Models.</p>		
Mapping of Course Outcomes for Unit V	CO5: Identify and assess the project risks and manage finances in line with Project Financial Management Process.	
Unit VI	Product Development & Entrepreneurship	(08 Hrs.)
<p><b>Product Development:</b> Introduction, Development Process and organizations, product planning, identifying customer needs, Product Significations, concept generation, selection, testing, Design for Manufacturing, Prototyping, Robust Design</p> <p><b>Entrepreneurship:</b> Concept, knowledge, and skills requirement; characteristic of successful entrepreneurs; entrepreneurship process; factors impacting emergence of entrepreneurship</p> <p><b>Legal issues related to Product development and Entrepreneurship:</b> Intellectual property rights- patents, trademarks, copyrights, trade secrets, licensing, franchising.</p>		
Mapping of Course Outcomes for Unit VI	CO6: Develop new products assessing their commercial viability and develop skillsets for becoming successful entrepreneurs while being fully aware of the legal issues related to Product development and Entrepreneurship.	

### Learning Resources

#### Text Books:

1. H.Kerzer, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", John Wiley & Sons, Inc., 10<sup>th</sup> Edition, 2009.
2. Chandra, P., "Projects", Tata McGraw-Hill Education, 8<sup>th</sup> Edition, 2009.



### Reference Books:

1. Morris, P. W. G. and Pinto, J. K., "The Wiley Guide to Managing Projects", John Wiley & Sons, 2004.
2. Karl Ulrich, Steven Eppinger, "Product Design and Development", McGraw Hill / Irvin, 3<sup>rd</sup> Edition 2009.
3. R. Majumdar, "Product Management in India", PHI, 2<sup>nd</sup> Edition, 2010.
4. G.S. Batra, "Development of Entrepreneurship", Deep and Deep publications, New Delhi.
5. Christine Petersen, "The Practical Guide to Project Management", PMP, 1<sup>st</sup> Edition, 2013.
6. Russell W. Darnall, John M. Preston, "Project Management from Simple to Complex", The Saylor Foundation.
7. Levy, F. K. and Wiest, J. D., "A Management Guide to PERT/CPM", Prentice Hall, 2<sup>nd</sup> Edition, 1969.
8. Lewis, R., "Project Management: Strategic Design and Implementation", McGraw-Hill, 5<sup>th</sup> Edition. 2006.
9. Venkataraman. R., J.K. Pinto, "Cost and Value Management in Projects", John Wiley & sons.

### MOOC / NPTEL Courses:

#### 1. NPTEL Course "Project Management for Managers"

Link of the Course: <https://nptel.ac.in/courses/110/107/110107081/>

#### 2. NPTEL Course on "Intellectual Property Rights and Competition Law"

Link of the Course: <https://nptel.ac.in/courses/110/105/110105139/>

### List of Tutorials to be carried out

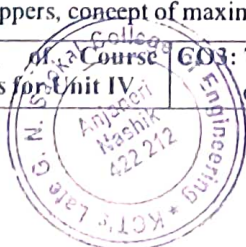
1.	Understanding Impact of Delays in Project Completions with a company's case study.
2.	Designing a Work Breakdown Structure (WBS) for any sample project.
3.	Case study on Conflict Resolution and understanding its challenges.
4.	Solve examples on Project scheduling using CPM and PERT Model.
5.	Assignment on Risk Identification and Risk Analysis with a company's example and/ or exploration of various project management tools.
6.	Prepare a Business plan for an sample Product/ Service to be launched.



Savitribai Phule Pune University		
Third Year of E & Te Engineering (2019 Course)		
304194: Power Devices & Circuits		
Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks
<b>Prerequisite Courses, if any:</b> 1. Basic Electrical Engineering 2. Basic Electronics Engineering 3. Electronic Circuits 4. Electrical Circuits		
<b>Companion Course, if any:</b> Power Devices & Circuits Lab		
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• To introduce different power devices viz. SCR, GTO, MOSFET and IGBT with construction, characteristics, repetitive and non repetitive ratings and typical triggering/driver circuits.</li> <li>• To understand working, design and performance analysis and applications of various power converter circuits such as ac to dc converters, inverter and chopper</li> <li>• To know various protection circuit requirements of power electronic devices.</li> </ul>		
<b>Course Outcomes:</b> On completion of the course, learner will be able -		
<b>CO1:</b> To differentiate based on the characteristic parameters among SCR, GTO, MOSFET & IGBT and identify suitability of the power device for certain applications and understand the significance of device ratings.		
<b>CO2:</b> To design triggering / driver circuits for various power devices.		
<b>CO3:</b> To evaluate and analyze various performance parameters of the different converters and its topologies.		
<b>CO4:</b> To understand significance and design of various protections circuits for power devices.		
<b>CO5:</b> To evaluate the performance of uninterruptible power supplies, switch mode power supplies and battery.		
<b>CO6:</b> To understand case studies of power electronics in applications like electric vehicles, solar systems etc.		



<b>Course Contents</b>		
<b>Unit I</b>	<b>Study of Power Devices</b>	<b>(06 Hrs.)</b>
Construction, VI characteristics (input, output and transfer if any), switching characteristics of SCR, GTO, Power MOSFET and IGBT, Performance overview of Silicon, Silicon Carbide & GaN based MOSFET and IGBT, various repetitive and non-repetitive ratings of SCR, GTO, Power MOSFET & IGBT and their significance, requirement of a typical triggering / driver (such as opto isolator) circuits for various power devices, importance of series and parallel operations of various power devices ( <b>no derivation and numerical</b> ).		
Mapping of Course Outcomes for Unit I	CO1: To differentiate based on the characteristic parameters among SCR, GTO, MOSFET & IGBT and identify suitability of the power device for certain applications and understand the significance of device ratings.  CO2: To design triggering / driver circuits for various power devices	
<b>Unit II</b>	<b>AC to DC Power Converters</b>	<b>(06 Hrs.)</b>
Concept of line & forced commutation, Single phase Semi & Full converters using SCR for R and R-L loads and its performance analysis and numerical, Effect of source inductance, Significance of power factor and its improvement using PWM based techniques, Three phase Full converters using SCR for R load and its performance analysis, Single Phase PWM Rectifier using IGBT, Three Phase Controlled Rectifier Using IGBT, Difference between SCR based conventional rectifiers and IGBT based rectifiers.		
Mapping of Course Outcomes for Unit II	CO3: To evaluate and analyze various performance parameters of the different converters and its topologies.	
<b>Unit III</b>	<b>DC to AC Converters</b>	<b>(06 Hrs.)</b>
Single phase half and full bridge square wave inverter for R and R-L load using MOSFET / IGBT and its performance analysis and numerical, Cross conduction in inverter, need of voltage control and strategies in inverters, classifications of voltage control techniques, control of voltage using various PWM techniques and their advantages, concept and need of harmonic elimination / reduction in inverters, Three Phase voltage source inverter for balanced star R load with 120 and 180 degree mode of operation, device utilization factor, Advanced Converters like matrix inverter, multi-level inverters and their topologies and its driver circuits (no derivation and numerical).		
Mapping of Course Outcomes for Unit III	CO3: To evaluate and analyze various performance parameters of the different converters and its topologies.	
<b>Unit IV</b>	<b>DC to DC Converters</b>	<b>(06 Hrs.)</b>
Classification of choppers, Step down chopper for R and RL load and its performance analysis, Step up chopper, various control strategies for choppers, types of choppers (isolated and non isolated) such as type A, B, C, D & E, switch mode power supply (SMPS) viz buck, boost and buck-boost, Fly back, Half and full Bridge isolated and non-isolated interleaved bidirectional topologies, and concept of integrated converter and design of LM3524 based choppers, concept of maximum power point tracking (MPPT).		
Mapping of Course Outcomes for Unit IV	CO3: To evaluate and analyze various performance parameters of the different converters and its topologies.	





Unit V	Power Devices Protection and Circuits	(06 Hrs.)
Over voltage, over current, di/dt and dv/dt protection circuits and their design, Various cooling techniques and heat sink design, Resonant converters such as Zero current switching (ZCS) and Zero voltage switching (ZVS), Electromagnetic interference such as radiated and conducted EMI, Difference between EMI and EMC, EMI sources and soft switching and minimizing / shielding techniques for EMI, Various EMI and EMC standards, Importance of isolation transformer.		
Mapping of Course Outcomes for Unit V	CO4: To understand significance and design of various protections circuits for power devices.	
Unit VI	Power Electronics Applications	(06 Hrs.)
AC Voltage Controller using IGBT & SCR, Fan Regulator, Electronic Ballast, LED Lamp driver, DC motor drive for single phase separately excited dc motor, BLDC motor drive, Variable voltage & variable frequency three phase induction motor drive, On-line and Off- line UPS, study of various selection criteria and performance parameters of batteries in battery operated power systems, battery charging models and modes for EVs, Architecture of EVs battery charger, PFC stage circuit topologies with details of Full-bridge boost rectifier and Full-bridge interleaved for EV battery charger, case study of power electronics in electric vehicle and photovoltaic solar system		
Mapping of Course Outcomes for Unit VI	CO5: To evaluate the performance of uninterruptible power supplies, switch mode power supplies and battery.	
	CO6: To understand case studies of power electronics in applications like electric vehicles, solar systems etc.	

### Learning Resources

#### Text Books:

1. M. H. Rashid, "Power Electronics Circuits Devices and Applications", PHI, 4<sup>th</sup> Edition 2017  
New Delhi.
2. M. D. Singh and K. B. Khanchandani, "Power Electronics", TMH, 2<sup>nd</sup> Edition 2006.



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