

**DAYANANDA SAGAR ACADEMY OF TECHNOLOGY & MANAGEMENT**



# **CURRICULUM**

**Scheme and Syllabus VII to VIII Semester**

Outcome Based Education

(Academic Year 2026-2027)

Department of Electrical & Electronics Engineering

7<sup>th</sup> & 8<sup>th</sup> Semester B.E

## **ABOUT THE INSTITUTE**

Dayananda Sagar Academy of Technology and Management- DSATM was established in 2011 with 5 UG Programmes and 1 PG Program, the programmes are approved by All India Council for Technical Education (AICTE) New Delhi, Affiliated to Visvesvaraya Technological University (VTU), Belagavi and DSATM is an autonomous institute from 2023-2024.

The Dayananda Sagar Institutions is one of pioneer institutions in India and abroad with six decades of excellence in Academic and Research. The newer campuses were necessary to accommodate the growing need of the technology and innovation.

DSATM nurtures the students in academic, research, sports, cultural and extracurricular activities.

- Creating an academic environment to nurture and develop competent entrepreneurs, leaders and professionals who are socially sensitive and environmentally conscious.
- Integration of Outcome Based Education and cognitive teaching and learning strategies to enhance learning effectiveness.
- Developing necessary infrastructure to cater to the changing needs of Business and Society.
- Optimum utilization of the infrastructure and resources to achieve excellence in all areas of relevance.
- Adopting learning beyond curriculum through outbound activities and creative assignments.
- Imparting contemporary and emerging techno-managerial skills to keep pace with the changing global trends.
- Facilitating greater Industry-Institute Interaction for skill development and employability enhancement.
- Establishing systems and processes to facilitate research, innovation and entrepreneurship for holistic development of students.
- Implementation of Quality Assurance System in all Institutional processes.

## **VISION OF THE INSTITUTE**

To strive at creating the institution a centre of highest calibre of learning, so as to create an overall intellectual atmosphere with each deriving strength from the other to be the best of engineers, scientists with management & design skills.

## **MISSION OF THE INSTITUTE**

- To serve its region, state, the nation and globally by preparing students to make meaningful contributions in an increasing complex global society challenges.
- To encourage, reflection on and evaluation of emerging needs and priorities with state-of-the-art infrastructure at institution.
- To support research and services establishing enhancements in technical, economic, human and cultural development.
- To establish interdisciplinary centre of excellence, supporting/ promoting student's implementation.
- To increase the number of Doctorate holders to promote research culture on campus.
- To establish IIPC, IPR, EDC, innovation cells with functional MOU's supporting student's quality growth.

## **QUALITY POLICY**

Dayananda Sagar Academy of Technology and Management aims at achieving academic excellence through continuous improvement in all spheres of Technical and Management education. In pursuit of excellence cutting – edge and contemporary skills are imparted to the utmost satisfaction of the students and the concerned stakeholders.

## **ABOUT THE DEPARTMENT**

The department established during the 2011-2012 academic session with an initial intake of 60 students, the EEE Department aims to provide quality professional education to students nationwide, with a special focus on the Karnataka region. We offer a four-year (8-semester) B.E. Programme under Visvesvaraya Technological University (VTU).

The department boasts excellent infrastructure, a highly talented teaching faculty, and a dedicated Training and Placement Cell, ensuring a bright future for our students. We are confident that our students will emerge as assets not only to this institution and the organizations they join but also to the country at large.

### **Credentials of the Department:**

- Accredited by NBA-AICTE, New Delhi
- Approved by AICTE, New Delhi
- Permanently affiliated with Visvesvaraya Technological University (VTU)

The EEE department at DSATM encompasses a wide range of traditional and disruptive technologies in core and IT fields, including Smart Grid, Advanced Meter Infrastructure (AMI), EV-Battery Management Systems, Microgrids, Distributed Energy Resources (DERs), Better Battery Technologies, Cybersecurity in the Power Industry, Blockchain Technology in the Energy Market, IoT/IIoT, and Automation. The flexibility and heterogeneity of the EEE program at DSATM equip students with special personal skills, making them successful engineers and entrepreneurs

## **VISION OF THE DEPARTMENT**

To impart quality education and to develop a supportive and collaborative learning environment to meet the challenges by innovation and integration, consequently reflecting effective progress of our students in making a real difference in their profession and society.

## **MISSION OF THE DEPARTMENT**

- M1: To provide a student-centric learning environment that facilitates the students to pursue their higher education.
- M2: To motivate the students to work professionally in several fields through

pedagogy teaching and learning process.

- M3: To help students in developing their overall professional competence and social awareness by providing value-based and behavioral training programs.

M4: To impart a supportive ecosystem to cultivate the innovation, research, and entrepreneurial culture in the faculty and students.

### **PROGRAM EDUCATION OBJECTIVES (PEO'S):**

- PEO-1: Graduates will excel in their profession and career by applying the concepts of Electrical and Electronics Engineering.
- PEO 2: Graduates will have the potential to work in diverse sub domains of professional field.
- PEO 3: Graduates will have the desire for higher education and lifelong learning.
- PEO 4: Graduates will have fidelity regarding ethical and social responsibilities.

### **PROGRAM OUTCOMES (PO's)**

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### **PROGRAM SPECIFIC OUTCOMES (PSO's)**

PSO-1: Able to formulate, investigate the various problems in Power Systems, Power Electronics, Control Systems, Electrical Machines and Drives for different application.

PSO-2: Able to inculcate the knowledge of sustainable technologies with modern tools.



**Dayananda Sagar Academy of Technology & Management**  
(Autonomous Institute under VTU)

Affiliated to **VTU**  
Approved by **AICTE**  
Accredited by **NAAC** with **A+** Grade  
6 Programs Accredited by **NBA**  
(CSE, ISE, ECE, EEE, MECH, CV)

**PROPOSED UG CREDIT STRUCTURE IN ALIGNMENT WITH VTU**

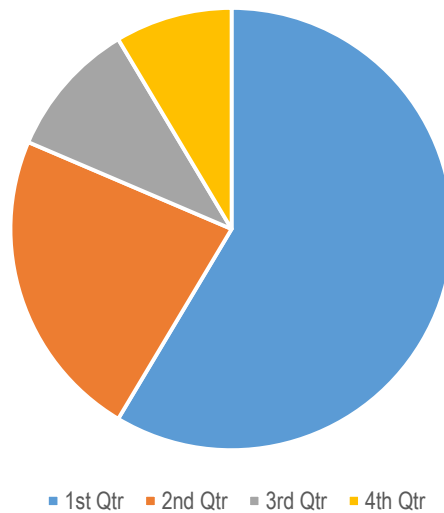
<b>Sl.No</b>	<b>Semester</b>	<b>No. of Credits</b>
1	1 <sup>st</sup> Semester	20
2	2 <sup>nd</sup> Semester	20
3	3 <sup>rd</sup> Semester	21
4	4 <sup>th</sup> Semester	21
5	5 <sup>th</sup> Semester	22
6	6 <sup>th</sup> Semester	22
7	7 <sup>th</sup> Semester	20
8	8 <sup>th</sup> Semester	14
<b>Total</b>		<b>160</b>

## Scheme Distribution

### Department of Electrical & Electronics Engineering

Course Component	Credits	% of Credits
Basic Science (BS)		
Engineering Science (ES)		
Humanities (HU)		
Program core (PC)		
Program core Integrated (PCI)		
Program core exclusive Lab		
Program elective (PE)		
Open Elective (OE)		
Internship (INT)		
Ability Enhancement course (AEC)		
Project (PR)		
<b>Total</b>	<b>160</b>	<b>100</b>

**Scheme-Credit Distribution**  
Plot the pie-chart







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## Scheme of Teaching and Examinations – 2024 Outcome Based Education (OBE) and Choice Based Credit System (CBCS) (Effective from 2026-27)

### 7<sup>th</sup> Semester: Electrical & Electronics Engineering (EEE)

Sl. No	Course Code	Course Title	Course Category	BOS	TD	Teaching Hours/Week					Credits	Examination			
						Lecture	Tutorial	Practical	Project	Total		SEE Duration (Hrs)	CIE Marks	SEE Marks	Total Marks
						L	T	P	S						
1	BEE701	Power System Operation and Control	PCC	EEE	EEE	3	2	0	0	5	4	3	50	50	100
2	BEE702	Programmable Logic Controllers	IPCC	EEE	EEE	3	2	0	0	5	4	3	50	50	100
3	BEE703X	Professional Elective Course	PEC	EEE	EEE	3	0	0	0	3	3	3	50	50	100
4	BEE704X	Open Elective Course	OEC	EEE	EEE	3	0	0	0	3	3	3	50	50	100
5	BEEP705	Project – Phase-2	PROJ	EEE	EEE	0	0	0	12	12	6	3	100	100	200
6	IKS	Indian Knowledge System	NCMC			1	0	0	0	1	--	--	100	-	100
7		AICTE Activity Points				80 AICTE Activity Points Earned									
<b>Total</b>						<b>14</b>	<b>2</b>	<b>0</b>	<b>12</b>	<b>28</b>	<b>20</b>	<b>--</b>	<b>400</b>	<b>300</b>	<b>700</b>

#### Professional Elective-II

BEE703A	AI Techniques for Electric and Hybrid Electric Vehicles
BEE703B	Big Data Analytics in Power Systems
BEE703C	Optimization Techniques
BEE703D	Introduction to Smart Grid Technology

#### Open Elective-I

BEE704A	Energy Conservation and Audit
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**8<sup>th</sup> Semester: Electrical & Electronics Engineering (EEE)**

Sl · No	Course Code	Course Title	Course Category	BOS	TD	Teaching Hours/Week					Credits	Examination				
						Lecture	Tutorial	Practical	Project	Total		SEE Duration (Hrs)	CIE Marks	SEE Marks	Total Marks	
						L	T	P	S							
1	BEEINT801	Internship (Industry/research) (14-20 weeks)	INT	EE E	EEE	Two contact hours/week for interaction between faculty and students					10	3	100	100	200	
2	BEEPS802	Capstone Project- Phase-3	SEM	EE E	EEE				8		4	--	100	---	100	
3		AICTE Activity Points	Details of 100 AICTE Activity Points Earned													
<b>Total</b>									8		<b>14</b>		200	100	300	

IPCC: Integrated Professional Core Course,

PEC: Professional Elective Course

OEC: Open Elective Course

PROJ: Project Work,

NCMC: Non-Credit Mandatory Course

L: Lecture,

T: Tutorial,

P: Practical

S= SDA: Skill Development Activity,

CIE: Continuous Internal Evaluation,

SEE: Semester End Evaluation.

**Integrated Professional Core Course (IPCC):** Refers to Integrated Professional Core Course Theory Integrated with practical's of the same course. Credit for IPCC can be 04 and its Teaching Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

**Non Credit Mandatory Course (NCMC) - National Service Scheme /Physical Education/Yoga:** All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of the degree.

**Newly introduced subjects in the syllabus**

<b>7<sup>th</sup> Semester</b>						
<b>1.</b>	<b>List of Existing Elective Courses</b>	<table border="1"> <tr> <td>BEE703C</td> <td>Optimization Techniques</td> </tr> <tr> <td>BEE703D</td> <td>Introduction to Smart Grid Technology</td> </tr> </table>	BEE703C	Optimization Techniques	BEE703D	Introduction to Smart Grid Technology
BEE703C	Optimization Techniques					
BEE703D	Introduction to Smart Grid Technology					
<b>2.</b>	<b>List of New Existing Elective Courses</b>	<table border="1"> <tr> <td>BEE703A</td> <td>AI Techniques for Electric and Hybrid Electric Vehicles</td> </tr> <tr> <td>BEE703B</td> <td>Big Data Analytics in Power Systems</td> </tr> </table>	BEE703A	AI Techniques for Electric and Hybrid Electric Vehicles	BEE703B	Big Data Analytics in Power Systems
BEE703A	AI Techniques for Electric and Hybrid Electric Vehicles					
BEE703B	Big Data Analytics in Power Systems					
<b>3.</b>	<b>List of New Industry Aligned Courses</b>	<table border="1"> <tr> <td>BEE702</td> <td>Programmable Logic Controllers</td> </tr> </table>	BEE702	Programmable Logic Controllers		
BEE702	Programmable Logic Controllers					

**Percentage of Change in the Syllabus**

<b>7<sup>th</sup> Semester</b>						
Sl.No	Course Code	Course Name	Topics Added	Topics removed	Revised in %	Justification
1.	BEE701	Power System Operation and Control	Economic Operation of Power System, unit commitment	Isolated power system, Steady state analysis, Control area concept, Proportional plus Integral Controller, Speed governor dead band and its effect on AGC, Digital LF Controllers, Decentralized control.	20%	<b>Topics of economic dispatch which was not in PSA were included by removing isolated power systems and dead band etc</b>

**7<sup>th</sup> SEMESTER**

**PROFESSIONAL CORE  
COURSE (PCC)**

### **PCC Course - Professional Core Course**

Teaching Hours/Week (L: T:P: S)	3:0:0:0 /2:2:0:0
Total Hours of Pedagogy	40 hours
Credits:	03
Each Module	8 Hrs
CIE Marks	50
SEE Marks	50
Total Marks	100
Exam Hours	3
Examination nature (SEE)	Theory

### **3 Credit Course – Professional Core Course (PCC)**

#### **Assessment Details (both CIE and SEE)**

- The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.
- The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).
- A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

#### **Continuous Internal Evaluation:**

#### **Internal Assessment Test (IAT):**

- For the Internal Assessment Test component of CIE, there are 25 marks and for Assignment component of the CIE, there are 25 marks. Two Tests, each of 50 Marks with 01-hour 30 minutes' duration, are to be conducted and average of two tests to be reduced to 25 marks
  - The first test will be administered after 40-50% of the syllabus has been covered, and
  - The second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of

assessment.

- Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as
- per the outcome defined for the course.

**The IA test questions are to be framed to map the Course Outcomes (COs), Program Outcomes (POs) and the Blooms RBT Levels. Emphasis to be given for higher order RBT levels**

### **Semester-End Examination:**

Theory SEE will be conducted as per the scheduled timetable (duration 03 hours).

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks.

### **Continuous and Comprehensive Assessment (CCA):**

Two of continuous and comprehensive assessment (CCA) to be conducted to attain COs and POs, evaluated each for **50 Marks**. Total Marks scored will be CCA1+CCA2 and scaled down to **10 Marks**.

- CCA1 after 4<sup>th</sup> week and CCA2 after 9<sup>th</sup> week. The evaluation includes either through quiz or rubrics
- CCA as project-based learning,
  - CCA is evaluated for **50 Marks** with review 1 of **20 Marks** after and review 2 of **30 Marks** includes project demonstration/competition and report submission.
  - The evaluation of review 1 after 6<sup>th</sup> weeks of semester and review 2 after 12<sup>th</sup> week of semester with project demonstration and submission of the report

Total score for CCA is **10 Marks**

Total Marks scored for theory component of CIE (IAT+ CCA) is **25 Marks**

### **Possible Continuous and Comprehensive Assessment (CCA):**

- Project based, Problem Based, Building Models, Lab-to-Land, Mobile Studio, Design and Programming Contest, Certification, Concept Map (Collage presentation/poster presentation), Case studies, Think-Pair-Share, Flipped classroom,
- The assessment of these techniques shall be in rubrics.

- The faculty can adopt any other CCA method of implementation and its assessment with prior approval of Program Assessment Committee (PAC).

**Professional Core Course (PCC) – 3 Credit course – Theory**

Assessment Method	Component	Type of Assessments	Syllabus Coverage	Maximum Marks	Average	Reduced Marks	Minimum Passing Marks	Evaluation Details
<b>Total CIE Theory + Practical</b>				<b>50</b>	----	----	<b>20</b>	
	<b>Theory</b>	Internal Assessment Test (IAT) - II	Module – 1 to 2.5	50	(50+50) / 2	<b>25</b>	10	Average of Two Internal test each of 50 Marks scale down the marks to 25
		Internal Assessment Test (IAT) - II	Module – 2.5 to 5	50				
	<b>Continuous Comprehensive Assessment (CCA)</b>	CCA-1- Pedagogical Initiatives / Activity Based learning	Considering all the Modules	50	(50+50) / 2	<b>25</b>	10	Two CCA methods as per VTU Clause 22OB4.2 of regulations to be adopted. If CCA chosen is Project Based Learning, then one assessment method may be adopted
		CCA-2- Pedagogical Initiatives / Activity Based learning		50				
	<b>Total CIE Theory</b>						<b>50</b>	20

<b>SEE</b>		Theory exam	Entire theory syllabus including questions from lab Component in respective Modules	100	----	50	20	SEE Exam is theory Exam conducted for 100 Marks, scored Marks are scaled down to 50 Marks
<b>CIE + SEE</b>				100	----	----	40	



# Dayananda Sagar Academy of Technology & Management

(Autonomous Institute under VTU)

Semester	:	7 <sup>th</sup>		
Course Title	:	Power System Operation and Control		
Course Code	:	BEE701		
Course Type (Theory/ Practical/ Integrated)	:	Theory		
Category	:	PCC		
Stream	:	EEE	CIE	: 50
Teaching hours/ week (L:T:P:S)	:	{3:2:0:0}	SEE	: 50
Total Hours	:	50	SEE	: 3 HOURS
Credits	:	04	Duration	

**Course Learning Objectives:** Students will be able to:

Sl. No	Course Objectives
1	To understand the principles of power system security and monitoring in modern interconnected power systems.
2	To study voltage regulation, control and reactive power control techniques used for maintaining voltage stability in power systems.
3	To analyze load control for economic operation of power systems including economic load dispatch and unit commitment.
4	To study and prepare automatic generation control (AGC) and the role of SCADA systems in real-time monitoring and control of power systems.

## Teaching-Learning Process

### Pedagogical Initiatives:

Some sample strategies to accelerate the attainment of various course outcomes are listed below:

- Adopt different teaching methods to attain the course outcomes.
- Include videos to demonstrate various concepts in C.
- Encourage collaborative (Group) Learning to encourage team building.
- Ask at least three **HOTS (Higher-order Thinking Skills)** module-wise questions to promote critical thinking.
- Adopt **Problem-Based Learning (PBL)**, which fosters students' analytical skills, and develops thinking skills such as evaluating, generalizing, and analyzing information rather than simply recalling it.
- Show different ways to solve a problem and encourage the students to come up with creative

and optimal solutions.

- Discuss various case studies to map with real-world scenarios and improve the understanding.
- Devise innovative pedagogy to improve

**Teaching-Learning Process (TLP).**

**Scheme of Teaching and Examinations for BE Programme -2026-27**

**Outcome Based Education and Choice Based Credit System (CBCS)**

**(Effective from the Academic Year 2026-27)**



**DSATM**

**COURSE CURRICULUM**

<b>Module No.</b>	<b>Topics</b>	<b>Hours</b>
<b>1</b>	<p><b>Introduction:</b> Operating States of Power System, Objectives of Control, Key Concepts of Reliable Operation, Preventive and Emergency Controls, Energy Management Centers.</p> <p><b>Supervisory Control and Data acquisition (SCADA):</b> Introduction, components, application in Power System, basic functions and advantages. Building blocks of SCADA system, components of RTU, communication subsystem, IED functional block diagram. R2 Classification of SCADA system: Single master–single remote; Single master–multiple RTU; Multiple master–multiple RTUs; and Single master, multiple submaster, multiple remote.</p>	<b>10</b>
<b>Pedagogy</b>	<b>Chalk and Talk / Experiential Learning / Animated/NPTEL videos / Group Discussion / Pictorial Demo / Case studies</b>	
<b>2</b>	<p><b>Automatic Generation Control (AGC):</b> Introduction, Schematic diagram of load frequency and excitation voltage regulators of turbo generators, Load frequency control (Single area case), Turbine speed governing system, Model of speed governing system, Turbine model, Generator load model,</p> <p><b>Automatic Generation Control in Interconnected Power system:</b> Two area load frequency control, Optimal (Two area) load frequency control by state variable, Automatic voltage control, Load frequency control with generation rate constraints (GRCs),</p>	<b>10</b>
<b>Pedagogy</b>	<b>Chalk and Talk / Experiential Learning / Animated/NPTEL videos / Group Discussion / Pictorial Demo / Case studies</b>	
<b>3</b>	<p><b>Economic Operation of Power System:</b> Introduction and Performance curves Economic generation scheduling neglecting losses and generator limits Economic generation scheduling including generator limits and neglecting losses Economic dispatch including transmission losses Derivation of transmission loss formula. Illustrative examples.</p> <p><b>Unit Commitment:</b> Introduction, Constraints and unit commitment solution by prior list method and dynamic forward DP approach (Flow chart and Algorithm only).</p>	<b>10</b>

Pedagogy	<b>Chalk and Talk / Experiential Learning / Animated/NPTEL videos / Group Discussion / Pictorial Demo / Case studies</b>	
4	<b>Control of Voltage and Reactive Power:</b> Introduction, Generation and absorption of reactive power, Relation between voltage, power and reactive power at a node, Methods of voltage control: i. Injection of reactive power, Shunt capacitors and reactors, Series capacitors, Synchronous compensators, Series injection. ii Tap changing transformers. Combined use of tap changing transformers and reactive power injection, Booster transformers, Phase shift transformers, Voltage collapse.	<b>10</b>
Pedagogy	<b>Chalk and Talk / Experiential Learning / Animated/NPTEL videos / Group Discussion / Pictorial Demo / Case studies</b>	
5	<b>Power System Security:</b> Introduction, Factors affecting power system security, Contingency Analysis, Linear Sensitivity Factors, AC power flow methods, Contingency Selection and Ranking. T2 State estimation of Power Systems: Introduction, Linear Least Square Estimation.	<b>8</b>
Pedagogy	<b>Chalk and Talk / Experiential Learning / Animated/NPTEL videos / Group Discussion / Pictorial Demo / Case studies</b>	
	<b>Pedagogical Initiatives (Not limited to):</b> <ul style="list-style-type: none"> <li>• <b>Think Pair and Share (Blended Learning):</b> provides an opportunity for students to learn from one another</li> <li>• <b>Problem Solving:</b> encourages cognitive thinking and enables creative problem solving</li> <li>• <b>Poster Presentation:</b> allows students to represent the concepts visually in order to understand the topics easily.</li> <li>• <b>Case studies:</b> maps different domains in real time applications</li> <li>• <b>Demonstration:</b> exhibits the implementation process</li> </ul>	

#### Text Books

Sl. No.	Title of the Book/Name of the author/Name of the publisher/Edition and Year
1	J. Nagrath and D. P. Kothari, <i>Power System Analysis</i> , 2nd ed. New Delhi, India: Tata McGraw-Hill, 2003.
2	D. P. Kothari and I. J. Nagrath, <i>Modern Power System Analysis</i> , 4th ed. New Delhi, India: McGraw-Hill Education, 2011.
3	A. J. Wood, B. F. Wollenberg, and G. B. Sheble, <i>Power Generation, Operation, and Control</i> , 3rd ed. Hoboken, NJ, USA: John Wiley & Sons, 2014.
4	U. Rao, <i>Power System Operation and Control</i> , 1st ed. New Delhi, India: PHI Learning Pvt. Ltd., 2012.

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

<b>CO</b>	<b>Course Outcomes</b>	<b>RBT Level</b>	<b>RBT Level Indicator</b>
<b>CO1</b>	Understand the operating states, control objectives, and reliability concepts of power systems, along with the architecture, components, and classifications of SCADA systems	<b>L1, L2</b>	<b>R/U</b>
<b>CO2</b>	Apply load frequency control, automatic generation control (AGC), and economic dispatch principles to single-area and multi-area power systems, including practical constraints such as generator limits and transmission losses	<b>L3</b>	<b>A</b>
<b>CO3</b>	Analyse voltage and reactive power control mechanisms, system stability issues (including voltage collapse), and evaluate power system security using contingency analysis and state estimation techniques.	<b>L4</b>	<b>An</b>
<b>CO4</b>	Design and simulate power system control strategies (AGC, economic dispatch, and voltage control) using modern computational tools	<b>L5</b>	<b>E</b>

**Mapping of Course Outcomes to Program Outcomes:**

<b>CO/PO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>													<b>3</b>		
<b>CO2</b>	<b>3</b>												<b>3</b>		<b>3</b>
<b>CO3</b>		<b>3</b>											<b>3</b>		
<b>CO4</b>			<b>3</b>	<b>3</b>	<b>3</b>				<b>3</b>	<b>3</b>				<b>3</b>	

**Weblinks and Video Lectures (e-Resources)**

<b>1</b>	<a href="https://onlinecourses.nptel.ac.in/noc23_ee128/preview">https://onlinecourses.nptel.ac.in/noc23_ee128/preview</a> Economic Operations And Control Of Power Systems, By Prof. Gururaj Mirle Vishwanath, Prof .Narayana Prasad Padhy   IIT Kanpur, MNIT Jaipur (On-lien from IIT Roorkee)
<b>2</b>	<a href="https://onlinecourses.nptel.ac.in/noc19_ee62/preview">https://onlinecourses.nptel.ac.in/noc19_ee62/preview</a> Power System Analysis, By Prof. Debapriya Das, IIT Kharagpur.

**CIE- Continuous Internal Evaluation (50 Marks)**

Bloom's Category	Theory				Practical
	Continuous Assessment Tests (IAT)		Continuous Comprehensive Assessment (CCA)		
	IAT-1	IAT-2	CCA-1	CCA-2	
	50 Marks	50 Marks	50 Marks	50 Marks	
<b>Remember</b>	10	10	10	10	10
<b>Understand</b>	10	10	10	10	10
<b>Apply</b>	20	20	10	10	20
<b>Analyse</b>	10	10	10	10	10
<b>Evaluate</b>			10	10	

**CIE Course Assessment Plan**

CO's	Marks Distribution						Total Marks	Weightage
	Test-1			Test-2				
	Module-1	Module-2	Module 2 to 2.5	Module-2.5 to 3	Module-4	Module-5		
<b>CO1</b>	<b>10</b>	<b>5</b>			<b>5</b>	<b>5</b>	<b>25</b>	<b>25</b>
<b>CO2</b>	<b>10</b>	<b>10</b>	<b>5</b>	<b>5</b>	<b>10</b>	<b>10</b>	<b>50</b>	<b>50</b>
<b>CO3</b>		<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>25</b>	<b>25</b>
<b>CO4</b>								
<b>Total</b>	<b>20</b>	<b>20</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>20</b>	<b>100</b>	<b>100</b>

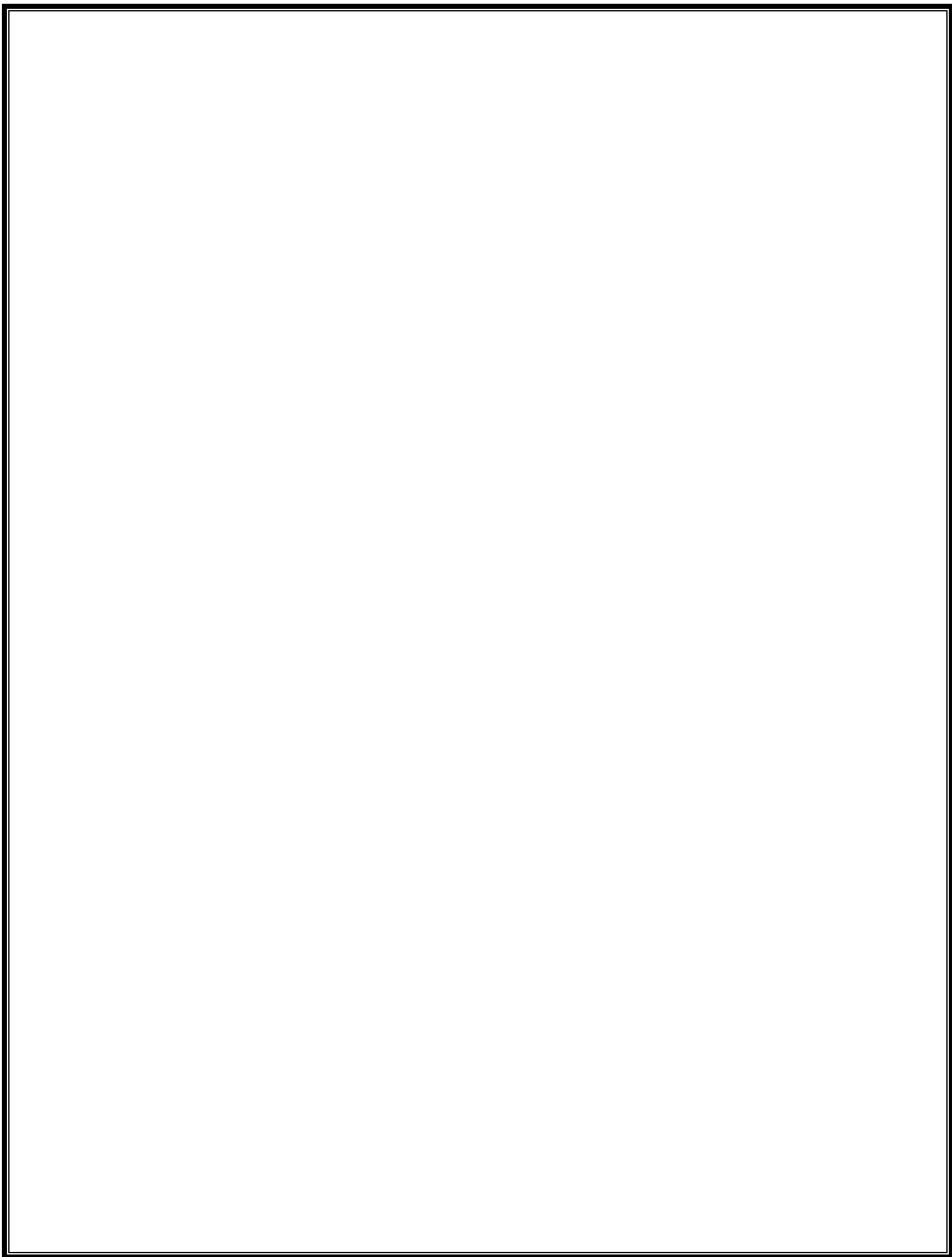
**SEE- Semester End Examination (50 Marks)**

Bloom's Category	SEE Marks (90% Theory+10% Practical Questions)
<b>Remember</b>	<b>10</b>
<b>Understand</b>	<b>10</b>
<b>Apply</b>	<b>20</b>

<b>Analyze</b>	<b>10</b>
<b>Evaluate</b>	
<b>Create</b>	

**SEE Course Plan**

<b>CO's</b>	<b>Marks Distribution</b>					<b>Total Marks</b>	<b>Weightage</b>
	<b>Module-1</b>	<b>Module-2</b>	<b>Module 3</b>	<b>Module-4</b>	<b>Module-5</b>		
<b>CO1</b>	<b>10</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>30</b>	<b>30</b>
<b>CO2</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>50</b>	<b>50</b>
<b>CO3</b>		<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>20</b>	<b>20</b>
<b>CO4</b>							
<b>Total</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>100</b>	<b>100</b>



**INTEGRATED  
PROFESSIONAL CORE  
COURSE (IPCC)**

## IPCC Course – Integrated Professional Core Course

Teaching Hours/Week (L: T:P: S)	2:2:2:0
Total Hours of Pedagogy	40 hours Theory + 20 Hours of Practical Classes
Credits:	04
Theory - Each Module	8 Hrs
Practical's	8-10 Programs / Experiments
CIE Marks	50
SEE Marks	50
Total Marks	100
Exam Hours	3
Examination nature (SEE)	Theory

- The theory part of the IPCC shall be evaluated both by CIE and SEE.
- The practical part shall be evaluated by only CIE (no SEE).
- However, questions from the practical part of IPCC shall be included in the SEE question paper.

### Integrated Professional Core Course (IPCC) - 4 Credit Course

#### Assessment Details (both CIE and SEE)

- The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.
- The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).
- A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

#### Continuous Internal Evaluation (CIE) for the Theory component of the IPCC (Maximum marks 50)

#### Internal Assessment Test (IAT):

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are 25 marks and that for the practical component is 25 marks.
- 25 marks for the theory component are split into 15 marks for two Internal Assessment Tests (Two Tests, each of 50 Marks with 01-hour 30 minutes' duration, are to be conducted and average of two tests to be reduced to 15 marks) and 10 marks for Two Continuous Comprehensive Assessment(CCA) methods.

- The first Internal test at the end of 40-50% coverage of the syllabus
- The second Internal test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for 25 marks).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**The IA test questions are to be framed to map the Course Outcomes (COs), Program Outcomes (POs) and the Revised Blooms Taxonomy (RBT) Levels. Emphasis to be given for Higher order Thinking Skills(HOTS).**

#### **Continuous Internal Evaluation (CIE) for the practical component of the IPCC**

- On completion of every experiment/program in the laboratory, the students shall be evaluated and Marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report, **05 Marks** are for conducting the experiment, **05 Marks** for preparation of the laboratory record, **5 Marks** for conducting Open Ended Experiments Each experiment. Marks of all experiments' write-ups are added to 15 marks.
- The Practical laboratory test (**duration 03 hours**) at the end of the 15<sup>th</sup> week of the semester/after completion of all the experiments (whichever is early) shall be conducted for **50 Marks** and scaled down to **5 Marks**.
- The open-ended experiment after completion of all the experiments shall be conducted for 20 marks with a split-up for 5 Marks for writeup, 10 Marks for Execution, and 5 Marks for Viva-Voce. Marks for writeup, Execution and Viva-Voce is added and scaled down to 05 marks.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 25 marks.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

#### **Semester End Examination (SEE) for IPCC Theory**

SEE will be conducted as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.

- The question paper shall be set for 100 Marks. The medium of the question paper shall be English.  
**The duration of SEE is 03 hours.**
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module. The two questions shall be of same course outcome, program outcome and Blooms RBT level. Emphasis to be given for higher order RBT levels.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored by the student shall be proportionally scaled down to 50 Marks.
- The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only.
- Questions mentioned in the SEE paper may include questions from the practical component.

#### **Continuous and Comprehensive Assessment (CCA):**

Two of continuous and comprehensive assessment (CCA) to be conducted to attain COs and POs, evaluated each for **50 Marks**. Total Marks scored will be  $(CCA1+CCA2)/2$  and scaled down to **10 Marks**.

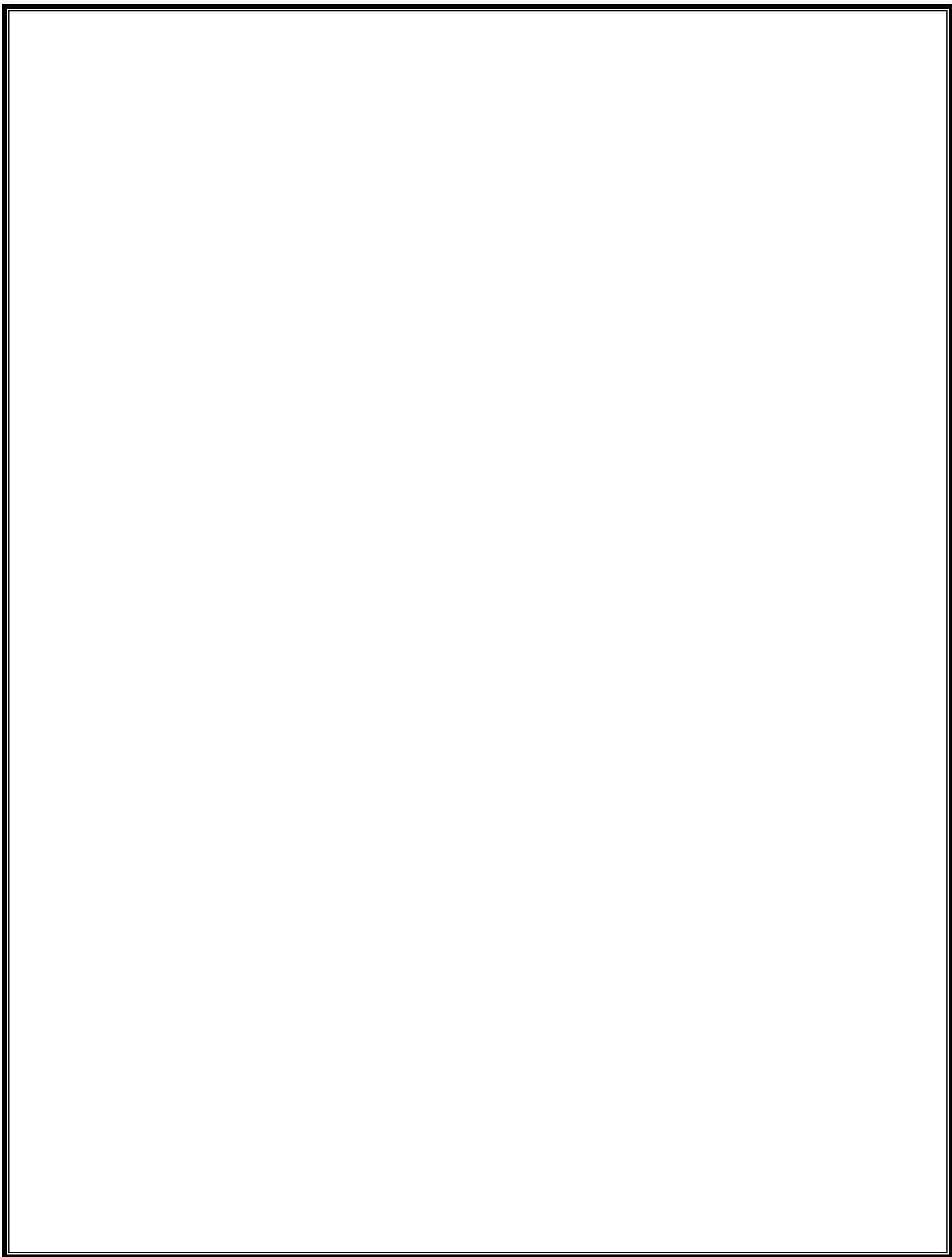
- CCA1 after 4<sup>th</sup> week and CCA2 after 9<sup>th</sup> week. The Assessment will be through rubrics.
- CCA as project-based learning,
  - CCA is evaluated for **50 Marks** with review 1 of **20 Marks** after and review 2 of **30 Marks** includes project demonstration/competition and report submission.
  - The evaluation of review 1 after 6<sup>th</sup> weeks of semester and review 2 after 12<sup>th</sup> week of semester with project demonstration and submission of the report

Total score for CCA is **10 Marks**

Total Marks scored for theory component of CIE (IAT+ CCA) is **25 Marks**

#### **Possible Continuous and Comprehensive Assessment (CCA):**

- Project based, Problem Based, Building Models, Lab-to-Land, Mobile Studio, Design and Programming Contest, Certification, Concept Map (Collage presentation/poster presentation), Case studies, Think-Pair-Share, Flipped classroom,
- The assessment of these techniques shall be in rubrics.
- The faculty can adopt any other CCA method of implementation and its assessment with prior approval of Program Assessment Committee (PAC).



**4 Credits Courses – Integrated Professional Core Course (IPCC)**

Assessment Method	Component	Type of Assessments	Syllabus Coverage	Maximum Marks	Average	Reduced Marks	Minimum Passing Marks	Evaluation Details
<b>Total CIE Theory + Practical</b>				<b>50</b>	----	----	<b>20</b>	
<b>CIE</b>	<b>Theory</b>	Internal Assessment Test (IAT) – I	Module – 1 to 2.5	50	$(50+50) / 2$	<b>15</b>	6	Average of Two Internal test each of 50 Marks scale down the marks to 15
		Internal Assessment Test (IAT) – II	Module – 2.5 to 5	50				
	<b>Continuous Comprehensive Assessment (CCA)</b>	CCA-1- Pedagogical Initiatives / Activity based learning	Considering all the Modules	50	$(50+50) / 2$	<b>10</b>	4	Two CCA methods as per VTU Clause 22OB4.2 of regulations to be adopted. If CCA chosen is Project Based Learning, then one assessment method may be adopted
		CCA-2- Pedagogical Initiatives/ Activity based learning		50				
	<b>Total CIE Theory</b>						<b>25</b>	10

CIE	Practical	Conduction of Experiments	Performance-Continuous Evaluation of each experiment	05	15	Average of all Experiments	15	4	Performance of the Experiment (On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. 20 marks are for conducting the experiment and calculations/observations/output )
			Record	05					
			Observation book	05					
		Practical Test	Write up	15	50	---	05	4	One Internal Practical Test after conduction of all Experiments for
			Execution	25					
			Viva-voce	10					
		Open Ended Experiment	Write up	05	20	---	05	2	One experiment for 20 marks. 20 marks reduced
			Execution	10					
			Viva-voce	05					
		<b>Total CIE Practical</b>							<b>25</b>

								Observation, Practical Test and Open-Ended Experiment
<b>SEE</b>		Theory exam	Entire theory syllabus including questions from lab Component in respective Modules	100	----	50	20	SEE Exam is theory Exam conducted for 100 Marks, scored Marks are scaled down to 50 Marks
<b>CIE + SEE</b>				100	----	----	40	

- The Minimum Marks to be secured in CIE to appear for SEE shall be 10 (40% of Maximum Marks – 25) in the Theory Component and 10 (40% of Maximum Marks – 25) in the Practical component.
- The Laboratory Component for the IPCC shall be for CIE only.
- However, in SEE, the Questions from the Laboratory Component shall be included in the respective Modules only.

Note: If few of the 3 Credit Courses are Integrated course type, for such courses the method suggested for 4 Credit IPCC Course shall be followed



**Dayananda Sagar Academy of Technology & Management**  
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<b>Semester</b>	:	<b>7<sup>th</sup> Sem</b>			
<b>Course Title</b>	:	<b>Programmable Logic Controllers</b>			
<b>Course Code</b>	:	<b>BEE702</b>			
<b>Course Type</b> (Theory/ Practical/ Integrated)	:	<b>Theory</b>			
<b>Category</b>	:	<b>IPCC</b>			
<b>Stream</b>	:	<b>EEE</b>	<b>CIE</b>	:	<b>50</b>
<b>Teaching hours/ week</b> (L:T:P:S)	:	<b>2:2:2:0</b>	<b>SEE</b>	:	<b>50</b>
<b>Total Hours</b>	:	<b>40</b>	<b>SEE</b>	:	<b>3</b>
<b>Credits</b>	:	<b>4</b>	<b>Duration</b>	:	

**Course Learning Objectives:** Students will be able to:

Sl. No	Course Objectives
1	To introduce the fundamentals of Programmable Logic Controllers (PLC), their hardware components, programming methods, and industrial applications.
2	To develop the ability to design, implement, and analyze PLC-based control systems using ladder logic, timers, counters, and data manipulation instructions for automation and process control.

**Teaching-Learning Process**

**Pedagogical Initiatives:**

Some sample strategies to accelerate the attainment of various course outcomes are listed below:

- Include videos to demonstrate various concepts.
- Encourage collaborative (Group) Learning to encourage team building.
- Adopt **Problem-Based Learning (PBL)**, which fosters students' analytical skills, and develops thinking skills such as evaluating, generalizing, and analyzing information rather than simply recalling it.
- Show different ways to solve a problem and encourage the students to come up with creative and optimal solutions.



DSATM

**Scheme of Teaching and Examinations for BE Programme -2024-25**

**Outcome Based Education and Choice Based Credit System (CBCS)**

**(Effective from the Academic Year 2024-25)**

**COURSE CURRICULUM**

<b>Module No.</b>	<b>Topics</b>	<b>Hours</b>
1	<p>Prerequisite: Basic knowledge of <b>electrical and electronic circuits, digital logic, industrial control components (relays, contactors, sensors), and basic computer programming concepts used in automation systems.</b></p> <p>Programmable Logic Controllers: Introduction, Parts of a PLC, Principles of Operation, Modifying the Operation, PLCs versus Computers, PLC Size and Application. PLC Hardware Components: The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications, The Central Processing Unit (CPU), Memory Design, Memory Types, Programming Terminal Devices, Recording and Retrieving Data, Human Machine Interfaces (HMIs) Basics of PLC Programming: Processor Memory Organization, Program Scan, PLC Programming Languages, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions, Programming Examine If Closed and Examine If Open Instructions, Entering the Ladder Diagram, Modes of Operation.</p>	8
<b>Pedagogy</b>	<b>Chalk and Talk / Experiential Learning / NPTEL videos</b>	
2	<p>Prerequisite: Basic knowledge of <b>electrical control components (relays, contactors, switches, sensors) and fundamental PLC ladder logic programming concepts.</b></p> <p>Developing Fundamental PLC Wiring Diagrams and Ladder Logic Programs: Electromagnetic Control Relays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Sensors, Output Control Devices, Seal-In Circuits, Latching Relays, Converting Relay Schematics into PLC Ladder Programs, Writing a Ladder Logic Program Directly from a Narrative Description. Programming Timers: Mechanical Timing Relays, Timer Instructions, On-Delay Timer Instruction, Off-Delay Timer Instruction, Retentive Timer, Cascading Timers</p>	8
<b>Pedagogy</b>	<b>Chalk and Talk / Experiential Learning / NPTEL videos</b>	
3	<p>Prerequisite : Basic understanding of <b>PLC programming, ladder logic, timers, and I/O operations, along with knowledge of industrial control devices and circuits.</b></p> <p>Programming Counters: Counter Instructions, Up-Counter, Down-Counter, Cascading Counters, Incremental Encoder-Counter Applications, Combining Counter and Timer Functions. Program Control Instructions: Master Control Reset</p>	8

	Instruction, Jump Instruction, Subroutine Functions, Immediate Input and Immediate Output Instructions, Forcing External I/O Addresses, Safety Circuitry, Selectable Timed Interrupt, Fault Routine, Temporary End Instruction, Suspend Instruction	
<b>Pedagogy</b>	<b>Chalk and Talk / Experiential Learning / NPTEL videos</b>	
<b>4</b>	<p>Prerequisite: Basic knowledge on <b>numerical data handling, and fundamental mathematical operations used in automation systems.</b></p> <p>Data Manipulation Instructions: Data Manipulation, Data Transfer Operations, Data Compare Instructions, Data Manipulation Programs, Numerical Data I/O Interfaces, Closed-Loop Control. Math Instructions: Math Instructions, Addition Instruction, Subtraction Instruction, Multiplication Instruction, Division Instruction, Other Word-Level Math Instructions, File Arithmetic Operations</p>	<b>8</b>
<b>Pedagogy</b>	<b>Chalk and Talk / Experiential Learning / NPTEL videos</b>	
<b>5</b>	<p>Prerequisite: knowledge on <b>process control principles, sequencing, and industrial automation systems including SCADA and network communications.</b></p> <p>Sequencer and Shift Register Instructions: Mechanical Sequencers, Sequencer Instructions, Sequencer Programs, Bit Shift Registers, Word Shift Operations. Process Control, Network Systems, and SCADA: Types of Processes, Structure of Control Systems, On/Off Control, PID Control, Motion Control, Data Communications, Supervisory Control and Data Acquisition (SCADA).</p>	<b>8</b>
	<p><b>Pedagogical Initiatives (Not limited to):</b></p> <ul style="list-style-type: none"> <li>• <b>Think Pair and Share (Blended Learning):</b> provides an opportunity for students to learn from one another</li> <li>• <b>Problem Solving:</b> encourages cognitive thinking and enables creative problem solving</li> <li>• <b>Poster Presentation:</b> allows students to represent the concepts visually in order to understand the topics easily.</li> <li>• <b>Case studies:</b> maps different domains in real time applications</li> <li>• <b>Demonstration:</b> exhibits the implementation process</li> </ul>	

**List of Programs:**

Sl. No.	Experiments/Programs
Experiments using Siemens PLC Kit	
1	PLC Programming using Basic gates
2	Direct online starter
3	Star delta starter for motor
4	Interlocking of motors
5	Sequence control of motors
6	Interfacing of sensors with PLC
Experiments using Delta Software	
7	Bottle fillings and motion control
8	Lift control
9	Lamp control
10	Water control

Text Books	
Sl. No.	Title of the Book/Name of the author/Name of the publisher/Edition and Year
1	Programmable Logic Controllers, Frank D Petruzella, McGraw Hill, 4th Edition, 2011
Reference Books	
1	Programmable Logic Controllers an Engineer's Guide, E A Parr Newnes, 3rd Edition, 2013
2	Introduction Programmable Logic Controllers, Gary Dunning, Cengage, 3rd Edition, 2006

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

CO	Course Outcomes	RBT Level	RBT Level Indicator
CO1	Explain the architecture, hardware components, and operating principles of PLCs along with basic PLC programming concepts and industrial control devices.	Understand	L2
CO2	Develop PLC ladder logic programs using timers, counters, relays, sensors, and I/O modules to implement basic industrial automation	Apply	L3
CO3	Analyze PLC control programs and system behavior using program control, data manipulation, and mathematical instructions for different automation scenarios.	Analyze	L4
CO4	Design and implement PLC-based automation systems integrating sequencing, process control techniques, communication networks, and SCADA systems for real-world industrial applications	Create	L6

<b>CO5</b>	Implementation of techniques using PLC Ladder Diagram and tool kit	<b>Evaluation</b>	<b>L5</b>
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### Mapping of Course Outcomes to Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>														
<b>CO2</b>	3												2	2
<b>CO3</b>		3												
<b>CO4</b>			3		3			2	3	2			2	2
<b>CO5</b>			3	2					3	2			2	2

### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Theory (25M)				Practical ( 25M)
	Continuous Assessment Tests (IAT)		Continuous Comprehensive Assessment (CCA)		
	IAT-1	IAT-2	CCA-1	CCA-2	
	50 Marks	50 Marks	50 Marks	50 Marks	
<b>Remember</b>	15	10	5	5	5
<b>Understand</b>	15	5	5	5	5
<b>Apply</b>	10	10	5	5	5
<b>Analyse</b>	5	10	5	5	5
<b>Evaluate</b>	5	5	5	5	5
<b>Create</b>		10	25	25	25



**PROFESSIONAL  
ELECTIVE COURSE  
(PEC)**

### **PEC Course - Professional Elective Course**

Teaching Hours/Week (L: T:P: S)	3:0:0:0
Total Hours of Pedagogy	40 hours
Credits:	03
Each Module	8 Hrs
CIE Marks	50
SEE Marks	50
Total Marks	100
Exam Hours	3
Examination nature (SEE)	Theory

### **3 Credit Course – Professional Elective Course (PEC)**

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this condition shall not be applicable to cases where the admission to the program is less than 10.

#### **Assessment Details (both CIE and SEE)**

- The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.
- The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).
- A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

#### **Continuous Internal Evaluation:**

#### **Internal Assessment Test (IAT):**

- For the Internal Assessment Test component of CIE, there are 25 marks and for Assignment component of the CIE, there are 25 marks. Two Tests, each of 50 Marks with 01-hour 30 minutes' duration, are to be conducted and average of two tests to be reduced to 25 marks

- The first test will be administered after 40-50% of the syllabus has been covered, and
- The second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.
- Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

**The IA test questions are to be framed to map the Course Outcomes (COs), Program Outcomes (POs) and the Blooms RBT Levels. Emphasis to be given for higher order RBT levels**

#### **Semester-End Examination:**

Theory SEE will be conducted as per the scheduled timetable (duration 03 hours).

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks.

#### **Continuous and Comprehensive Assessment (CCA):**

Two of continuous and comprehensive assessment (CCA) to be conducted to attain COs and POs, evaluated each for **50 Marks**. Total Marks scored will be CCA1+CCA2 and scaled down to **10 Marks**.

- CCA1 after 4<sup>th</sup> week and CCA2 after 9<sup>th</sup> week. The evaluation includes either through quiz or rubrics
- CCA as project-based learning,
  - CCA is evaluated for **50 Marks** with review 1 of **20 Marks** after and review 2 of **30 Marks** includes project demonstration/competition and report submission.
  - The evaluation of review 1 after 6<sup>th</sup> weeks of semester and review 2 after 12<sup>th</sup> week of semester with project demonstration and submission of the report

Total score for CCA is **10 Marks**

Total Marks scored for theory component of CIE (IAT+ CCA) is **25 Marks**

**Possible Continuous and Comprehensive Assessment (CCA):**

- Project based, Problem Based, Building Models, Lab-to-Land, Mobile Studio, Design and Programming Contest, Certification, Concept Map (Collage presentation/poster presentation), Case studies, Think-Pair-Share, Flipped classroom,
- The assessment of these techniques shall be in rubrics.
- The faculty can adopt any other CCA method of implementation and its assessment with prior approval of Program Assessment Committee (PAC).

**Professional Elective Course (PEC) – 3 Credit course – Theory**

Assessment Method	Component	Type of Assessments	Syllabus Coverage	Maximum Marks	Average	Reduced Marks	Minimum Passing Marks	Evaluation Details
<b>Total CIE Theory + Practical</b>				<b>50</b>	----	----	<b>20</b>	
	<b>Theory</b>	Internal Assessment Test (IAT) - II	Module – 1 to 2.5	50	(50+50) / 2	<b>25</b>	10	Average of Two Internal test each of 50 Marks scale down the
		Internal Assessment Test (IAT) - II	Module – 2.5 to 5	50				
	<b>Continuous Comprehensive Assessment (CCA)</b>	CCA-1- Pedagogical Initiatives / Activity Based learning	Considering all the Modules	50	(50+50) / 2	<b>25</b>	10	Two CCA methods as per VTU Clause 22OB4.2 of regulations to be adopted. If CCA chosen is Project Based Learning, then one assessment method may be adopted
		CCA-2- Pedagogical Initiatives / Activity Based learning		50				
	<b>Total CIE Theory</b>						<b>50</b>	20

<b>SEE</b>		Theory exam	Entire theory syllabus including questions from lab Component in respective Modules	100	----	50	20	SEE Exam is theory Exam conducted for 100 Marks, scored Marks are scaled down to 50 Marks
<b>CIE + SEE</b>				100	----	----	40	



# Dayananda Sagar Academy of Technology & Management

(Autonomous Institute under VTU)

Semester	:	7 <sup>TH</sup>		
Course Title	:	AI Techniques for Electric and Hybrid Electric Vehicles		
Course Code	:	BEE703A		
Course Type (Theory/ Practical/ Integrated)	:	Theory		
Category	:	PEC		
Stream	:	EEE	CIE	: 50
Teaching hours/ week (L:T:P:S)	:	(3:0:0:0)	SEE	: 50
Total Hours	:	40	SEE	: 3 HOURS
Credits	:	3	Duration	

**Course Learning Objectives:** Students will be able to:

Sl. No	Course Objectives
1	To explain the architecture and operation of IoT-based Battery Management Systems (BMS) and different types of batteries used in electric and hybrid electric vehicles.
2	To understand the application of artificial intelligence techniques for control and optimization of BLDC motor drives used in electric vehicles.
3	To study optimization techniques and control strategies used in Active Magnetic Bearing (AMB) systems for electric vehicle applications.
4	To analyze the modeling and performance of power converters and hybrid energy storage systems (HESS) for efficient energy management in EVs and PHEVs.

## Teaching-Learning Process

### Pedagogical Initiatives:

Some sample strategies to accelerate the attainment of various course outcomes are listed below:

- Adopt different teaching methods to attain the course outcomes.
- Include videos to demonstrate various concepts in C.
- Encourage collaborative (Group) Learning to encourage team building.
- Ask at least three **HOTS (Higher-order Thinking Skills)** module-wise questions to promote critical thinking.
- Adopt **Problem-Based Learning (PBL)**, which fosters students' analytical skills, and develops

thinking skills such as evaluating, generalizing, and analyzing information rather than simply recalling it.

- Show different ways to solve a problem and encourage the students to come up with creative and optimal solutions.
- Discuss various case studies to map with real-world scenarios and improve the understanding.
- Devise innovative pedagogy to improve **Teaching-Learning Process (TLP)**.



DSATM

### Scheme of Teaching and Examinations for BE Programme -2026-27

### Outcome Based Education and Choice Based Credit System (CBCS)

(Effective from the Academic Year 2026-27)

#### COURSE CURRICULUM

Module No.	Topics	Hours
1	<b>IoT Based Battery Management System (BMS) for Hybrid Electric Vehicles (HEV) :</b> Introduction, Battery configuration, Types of batteries for HEV and Electric Vehicles (EV), Functional Blocks of Battery Management Systems, IoT based BMS.	8
Pedagogy	<b>Chalk and Talk / Experiential Learning / Animated/NPTEL videos / Group Discussion / Pictorial Demo / Case studies</b>	
2	<b>Brushless Direct Current Motor Drive Using Artificial Intelligence for Optimum Operation of the Electric Vehicle:</b> Basics of Artificial Intelligence, Advantages of Artificial Intelligence in EV, Brushless DC Motor, Mathematical Representation Brushless DC Motor, Closed-Loop Model of BLDC Motor Drive, PID Controller, Fuzzy Control, Auto-Tuning Type Fuzzy PID Controller, Genetic Algorithm, Artificial Neural Network-Based Controller, BLDC Motor Speed Controller with ANN Based PID Controller, Analysis of Different Speed Controllers.	8
Pedagogy	<b>Chalk and Talk / Experiential Learning / Animated/NPTEL videos / Group Discussion / Pictorial Demo / Case studies</b>	
3	<b>Optimization Techniques Used in Active Magnetic Bearing System for Electric Vehicles:</b> Basic Components of an Active Magnetic Bearing (AMB), Active Magnetic Bearing in Electric Vehicles System, Control Strategies for AMB in EVs.	8
Pedagogy	<b>Chalk and Talk / Experiential Learning / Animated/NPTEL videos / Group Discussion / Pictorial Demo / Case studies</b>	

4	<b>Small-Signal Modeling Analysis of Three-Phase Power Converters for EV Applications</b> Introduction, Overall System Modeling, Mathematical Modeling and Analysis of Small Signal Modeling.	8
Pedagogy	<b>Chalk and Talk / Experiential Learning / Animated/NPTEL videos / Group Discussion / Pictorial Demo / Case studies</b>	
5	<b>Energy Management of Hybrid Energy Storage System (HESS) in PHEV With Various Driving Mode:</b> Introduction, Problem Description, and Formulation, Modeling of HESS and its Analysis.	8
Pedagogy	<b>Chalk and Talk / Experiential Learning / Animated/NPTEL videos / Group Discussion / Pictorial Demo / Case studies</b>	
	<b>Pedagogical Initiatives (Not limited to):</b> <ul style="list-style-type: none"> <li>• <b>Think Pair and Share (Blended Learning):</b> provides an opportunity for students to learn from one another</li> <li>• <b>Problem Solving:</b> encourages cognitive thinking and enables creative problem solving</li> <li>• <b>Poster Presentation:</b> allows students to represent the concepts visually in order to understand the topics easily.</li> <li>• <b>Case studies:</b> maps different domains in real time applications</li> <li>• <b>Demonstration:</b> exhibits the implementation process</li> </ul>	

#### Text Books

Sl. No.	Title of the Book/Name of the author/Name of the publisher/Edition and Year
1	A. Chitra, P. Sanjeevikumar, and S. Himavathi, <i>Artificial Intelligent Techniques for Electric and Hybrid Electric Vehicles</i> . Hoboken, NJ, USA: Wiley, 2020.
2	T. Jili, R. Zhang, and L. Ma, <i>Application of Artificial Intelligence in Hybrid Electric Vehicle Energy Management</i> , 1st ed. Amsterdam, Netherlands: Elsevier, 2024.

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

CO	Course Outcomes	RBT Level	RBT Level Indicator
CO1	Understand the architecture and operation of IoT-based Battery Management Systems (BMS), types of batteries used in EV/HEV, and their role in electric vehicle performance.	L1, L2	R/U

<b>CO2</b>	Apply artificial intelligence techniques such as fuzzy logic, genetic algorithms, and neural networks for analysis and control of BLDC motor drives in electric vehicles.	<b>L3</b>	<b>A</b>
<b>CO3</b>	Analyze optimization techniques and control strategies used in Active Magnetic Bearing (AMB) systems and evaluate their application in electric vehicle systems.	<b>L4</b>	<b>An</b>
<b>CO4</b>	Evaluate and model power electronic converters and hybrid energy storage systems (HESS) for efficient energy management in electric and plug-in hybrid electric vehicles.	<b>L5</b>	<b>E</b>

**Mapping of Course Outcomes to Program Outcomes:**

<b>CO/PO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>															
<b>CO2</b>	<b>3</b>												<b>3</b>		<b>3</b>
<b>CO3</b>		<b>3</b>											<b>3</b>		
<b>CO4</b>			<b>3</b>	<b>3</b>	<b>3</b>				<b>3</b>	<b>3</b>				<b>3</b>	

**Weblinks and Video Lectures (e-Resources)**

<b>1</b>	Introduction to "Electric and Hybrid Electric Vehicles" <a href="https://onlinecourses.swayam2.ac.in/e-learning/preview/nou25_ec13">https://onlinecourses.swayam2.ac.in/e-learning/preview/nou25_ec13</a>
<b>2</b>	<b>NOC: Fundamentals of Electric vehicles: Technology &amp; Economics, IIT Madras</b> Prof. Ashok Jhunjunwala Prof. Prabhjot Kaur Prof. Kaushal Kumar Jha Prof. L Kannan <a href="https://onlinecourses.swayam2.ac.in/e-learning/preview/nou25_ec13">https://onlinecourses.swayam2.ac.in/e-learning/preview/nou25_ec13</a>

**CIE- Continuous Internal Evaluation (50 Marks)**

Bloom's Category	Theory			
	Continuous Assessment Tests (IAT)		Continuous Comprehensive Assessment (CCA)	
	IAT-1	IAT-2	CCA-1	CCA-2
	50 Marks	50 Marks	50 Marks	50 Marks
<b>Remember</b>	10	10	10	10
<b>Understand</b>	10	10	10	10
<b>Apply</b>	20	20	10	10
<b>Analyse</b>	10	10	10	10
<b>Evaluate</b>			10	10

**CIE Course Assessment Plan**

CO's	Marks Distribution						Total Marks	Weightage
	Test-1			Test-2				
	Module-1	Module-2	Module 2 to 2.5	Module-2.5 to 3	Module-4	Module-5		
<b>CO1</b>	<b>10</b>	<b>5</b>			<b>5</b>	<b>5</b>	<b>25</b>	<b>25</b>
<b>CO2</b>	<b>10</b>	<b>10</b>	<b>5</b>	<b>5</b>	<b>10</b>	<b>10</b>	<b>50</b>	<b>50</b>
<b>CO3</b>		<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>25</b>	<b>25</b>
<b>CO4</b>								
<b>Total</b>	<b>20</b>	<b>20</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>20</b>	<b>100</b>	<b>100</b>

**SEE- Semester End Examination (50 Marks)**

<b>Bloom's Category</b>	<b>SEE Marks (90% Theory+10% Practical Questions)</b>
<b>Remember</b>	<b>10</b>
<b>Understand</b>	<b>10</b>
<b>Apply</b>	<b>20</b>
<b>Analyse</b>	<b>10</b>

**SEE Course Plan**

<b>CO's</b>	<b>Marks Distribution</b>					<b>Total Marks</b>	<b>Weightage (%)</b>
	<b>Module-1</b>	<b>Module-2</b>	<b>Module-3</b>	<b>Module-4</b>	<b>Module-5</b>		
<b>CO1</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>5</b>	<b>45</b>	<b>45</b>
<b>CO2</b>	<b>10</b>	<b>5</b>	<b>0</b>	<b>10</b>	<b>10</b>	<b>35</b>	<b>35</b>
<b>CO3</b>	<b>0</b>	<b>5</b>	<b>5</b>	<b>0</b>	<b>10</b>	<b>20</b>	<b>20</b>
<b>CO4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>00</b>	<b>00</b>
<b>Total</b>	<b>20</b>	<b>20</b>	<b>15</b>	<b>20</b>	<b>25</b>	<b>100</b>	<b>100</b>



# Dayananda Sagar Academy of Technology & Management

(Autonomous Institute under VTU)

Semester	:	7 <sup>th</sup>			
Course Title	:	Big Data Analytics in Power Systems			
Course Code	:	BEE703B			
Course Type (Theory/ Practical/ Integrated)	:	Theory			
Category	:	PEC			
Stream	:	EEE	CIE	:	50
Teaching hours/ (L:T:P:S)	:	2:2:0:0	SEE	:	50
Total Hours	:	40	SEE	:	3 hrs
Credits	:	3	Duration	:	

**Course Learning Objectives:** Students will be able to:

Sl. No	Course Objectives
1	To understand the concept of big data and its relevance to power systems.
2	To learn data acquisition and management techniques in smart grids.
3	To apply data analytics and machine learning methods to power system problems.
4	To analyze large-scale energy data from modern grid infrastructure.

## Teaching-Learning Process

### Pedagogical Initiatives:

Some sample strategies to accelerate the attainment of various course outcomes are listed below:

- Adopt different teaching methods to attain the course outcomes.
- Include videos to demonstrate various concepts in C.
- Encourage collaborative (Group) Learning to encourage team building.
- Ask at least three **HOTS (Higher-order Thinking Skills)** module-wise questions to promote critical thinking.
- Adopt **Problem-Based Learning (PBL)**, which fosters students' analytical skills, and develops thinking skills such as evaluating, generalizing, and analyzing information rather than simply

recalling it.

- Show different ways to solve a problem and encourage the students to come up with creative and optimal solutions.
- Discuss various case studies to map with real-world scenarios and improve the understanding.
- Devise innovative pedagogy to improve **Teaching-Learning Process (TLP)**.



**DSATM**

**Scheme of Teaching and Examinations for BE Programme -2026-27**  
**Outcome Based Education and Choice Based Credit System (CBCS)**  
**(Effective from the Academic Year 2026-27)**

**COURSE CURRICULUM**

<b>Module No.</b>	<b>Topics</b>	<b>Hours</b>
<b>1</b>	Introduction: Big Data, Future Power Systems. Big Data Application and Analytics in a Large - Scale Power System: Introduction, General Applications of Big Data, Algorithms for Processing Big Data, Application of Big Data in Power Systems	<b>8</b>
<b>Pedagogy</b>	<b>Chalk and Talk / Group Discussion</b>	
<b>2</b>	Role of Big Data in Smart Grid Communications: Introduction, The Grid Modernization, The Grid Interconnection with the Internet of Things, Data Traffic Pattern in a Smart Grid Environment, The Massive Flow of Information in a Smart Scenario ,The Volume of Generated Data in a Smart Distribution System: A Case of Study. Big Data Optimization in Electric Power Systems: Introduction, Background, Scientometric Analysis of Big Data, Big Data and Power Systems, Optimization Techniques Used in the Big Data Analysis	<b>8</b>
<b>Pedagogy</b>	<b>Chalk and Talk / Experiential Learning / Animated/NPTEL videos</b>	
<b>3</b>	Security Methods for Critical Infrastructure Communications: Introduction, Effects of Successful Communication System Threats, General Communication System Operations, Industrial Control Networks and Operations, High-Level Communication System Threats, Cyber Threats and Security. Data - Mining Methods for Electricity Theft Detection: Introduction, Transmission and Distribution System Losses, Electricity Theft Methods, Data Mining and Electricity Theft, Issues and Directions in Electricity Theft-Related Data-Mining Research.	<b>8</b>
<b>Pedagogy</b>	<b>Chalk and Talk / Experiential Learning</b>	
<b>4</b>	Unit Commitment Control of Smart Grids: Introduction, Renewable Energy Resources, The Unit Commitment Problem, A Multi-agent Architecture, Illustrative Example	<b>8</b>
<b>Pedagogy</b>	<b>Chalk and Talk / Animated/NPTEL videos / Group Discussion / Case studies</b>	

<b>5</b>	Transformer Differential Protection Algorithm Based on Data Pattern Recognition: Big Data and Power System Protection, Methods for Differential Protection Blocking, Principal Component Analysis, Curvilinear Component Analysis (CCA), PCA Applied to Discriminate Between Inrush and Fault, Currents in Transformers, Application of the CCA as a Base for a Differential Protection System Under Study, Results.	<b>8</b>
<p><b>Pedagogical Initiatives (Not limited to):</b></p> <ul style="list-style-type: none"> <li>• <b>Think Pair and Share (Blended Learning):</b> provides an opportunity for students to learn from one another</li> <li>• <b>Problem Solving:</b> encourages cognitive thinking and enables creative problem solving</li> <li>• <b>Poster Presentation:</b> allows students to represent the concepts visually in order to understand the topics easily.</li> <li>• <b>Case studies:</b> maps different domains in real time applications</li> <li>• <b>Demonstration:</b> exhibits the implementation process</li> </ul>		

**Text Books**

Sl. No.	Title of the Book/Name of the author/Name of the publisher/Edition and Year
1	Big Data Analytics in Future Power Systems Ahmed F. Zobaa and Trevor J. Bihl CRC Press 2019. 2019.

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

CO	Course Outcomes	RBT Level	RBT Level Indicator
CO1	Explain the fundamentals of big data and its significance in modern power systems.	L1	R
CO2	Demonstrate knowledge of data acquisition, storage, and management techniques used in smart grid environments.	L2	U
CO3	Apply data analytics and machine learning techniques to solve practical problems in power systems.	L3	A
CO4	Analyze and interpret large-scale energy data from modern grid infrastructure for decision-making and optimization.	L4	An

**Mapping of Course Outcomes to Program Outcomes:**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2		3													
CO3			3												
CO4				3	2								2		

**CIE- Continuous Internal Evaluation (50 Marks)**

Bloom's Category	Theory			
	Continuous Assessment Tests (IAT)		Continuous Comprehensive Assessment (CCA)	
	IAT-1	IAT-2	CCA-1	CCA-2
	50 Marks	50 Marks	50 Marks	50 Marks
Remember	10	10	10	10
Understand	10	10	10	10
Apply	20	20	10	10
Analyze	10	10	10	10

**CIE Course Assessment Plan**

CO's	Marks Distribution						Total Marks	Weightage
	Test-1			Test-2				
	Module-1	Module-2	Module 2 to 2.5	Module-2.5 to 3	Module-4	Module-5		
CO1	15	5	5	5	5	5	40	40
CO2	5	5	0	0	5	5	20	20
CO3	0	5	5	0	5	5	20	20
CO4	0	5	0	0	5	0	10	10





## Dayananda Sagar Academy of Technology & Management

(Autonomous Institute under VTU)

<b>Semester</b>	:	7 <sup>th</sup>	
<b>Course Title</b>	:	<b>Optimization Techniques</b>	
<b>Course Code</b>	:	<b>BEE703C</b>	
<b>Course Type</b> (Theory/ Practical/ Integrated)	:	<b>Theory</b>	
<b>Category</b>	:	<b>Elective Course</b>	
<b>Stream</b>	:	<b>Electrical &amp; Electronics Branch</b>	<b>CIE</b> : <b>50 Marks</b>
<b>Teaching hours/ week</b> (L:T:P:S)	:	<b>3:1:0:0</b>	<b>SEE</b> : <b>50 Marks</b>
<b>Total Hours</b>	:	<b>40 Hrs Theory</b>	<b>SEE</b> : <b>3 Hours</b>
<b>Credits</b>	:	<b>03</b>	<b>Duration</b>

**Course Learning Objectives:** Students will be taught

Sl. No.	Course Objectives
<b>1</b>	To understand the fundamental concepts of linear programming, nonlinear programming, and dynamic programming, including their mathematical formulations and solution techniques.
<b>2</b>	To apply optimization techniques such as simplex method, transportation models, assignment problems, and Lagrange multiplier method to solve real-world engineering and management problems.
<b>3</b>	To analyse optimization models using duality theory, sensitivity analysis, KKT conditions, and interior point methods to evaluate optimality and efficiency of solutions.
<b>4</b>	To design and develop optimization models using dynamic programming, nonlinear programming, and advanced optimization algorithms for complex decision-making problems.

### Teaching-Learning Process

#### Pedagogy (General Instructions):

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the infrastructures and the mechanism involved in the principle.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOT (Higher-order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.

6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Individual teachers can devise innovative pedagogy to improve teaching-learning.



**DSATM**

**Scheme of Teaching and Examinations for BE Programme -2026-27  
Outcome Based Education and Choice Based Credit System (CBCS)  
(Effective from the Academic Year 2026-27)**

**COURSE SYLLABUS**

Module No.	Contents of the Module	Hours
<b>1</b>	<b>LINEAR PROGRAMMING:</b> Introduction - formulation of linear programming model-Graphical solution– solving LPP using simplex algorithm – Revised Simplex Method.	<b>8</b>
<b>Pedagogy</b>	1. Chalk and talk/NPTEL videos 2. Problem Based Learning	
<b>2</b>	<b>ADVANCES IN LP:</b> Duality theory- Dual simplex method - Sensitivity analysis–Transportation problems–Assignment problems-Travelling sales man problem -Data Envelopment Analysis.	<b>8</b>
<b>Pedagogy</b>	1. Chalk and talk/NPTEL videos 2. Problem Based Learning	
<b>3</b>	<b>NON LINEAR PROGRAMMING:</b> Classification of Non Linear programming – Lagrange multiplier method – Karush – Kuhn Tucker conditions–Reduced gradient algorithms–Quadratic programming method – Penalty and Barrier method.	<b>8</b>
<b>Pedagogy</b>	1. Chalk and talk/NPTEL videos 2. Problem Based Learning	
<b>4</b>	<b>INTERIOR POINT METHODS:</b> Karmarkar’s algorithm–Projection Scaling method–Dual affine algorithm–Primal affine algorithm Barrier algorithm.	<b>8</b>
<b>Pedagogy</b>	1. Chalk and talk/NPTEL videos 2. Problem Based Learning 3. Demonstration	
<b>5</b>	<b>DYNAMIC PROGRAMMING:</b> Formulation of Multi stage decision problem–Characteristics–Concept of sub-optimization and the principle of optimality–Formulation of Dynamic programming–Backward and Forward recursion– Computational procedure– Conversion of final value problem in to Initial value problem	<b>8</b>
<b>Pedagogy</b>	1. Chalk and talk/NPTEL videos 2. Problem Based Learning 3. Demonstration	

<b>Text Books</b>	
<b>Sl. No.</b>	<b>Title of the Book/Name of the author/Name of the publisher/Edition and Year</b>
<b>1</b>	Engineering Optimization Theory and Practice S. S. Rao John Wiley & Sons Fourth Edition 2009
<b>2</b>	Hillier and Lieberman “Introduction to Operations Research”, TMH, 2000
<b>Reference Books</b>	
<b>1</b>	R.Panneerselvam, “Operations Research”, PHI, 2006
<b>2</b>	Hamdy ATaha, “Operations Research –An Introduction”, Prentice Hall India, 2003.

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

<b>CO</b>	<b>Course Outcomes</b>	<b>RBT Level</b>	<b>Level Indicator</b>
<b>CO1</b>	Understand the basic concepts of linear programming models, graphical solutions, simplex method, and revised simplex method.	<b>L1 &amp; L2</b>	<b>Remember and Understand</b>
<b>CO2</b>	Apply optimization techniques to solve transportation problems, assignment problems, travelling salesman problems, and nonlinear programming problems.	<b>L3</b>	<b>Apply</b>
<b>CO3</b>	Analyze optimization problems using duality theory, sensitivity analysis, Karush–Kuhn–Tucker conditions, and interior point methods to interpret optimal solutions.	<b>L4</b>	<b>Analyse</b>
<b>CO4</b>	Design and formulate dynamic programming models and advanced optimization strategies for multistage decision-making problems.	<b>L5</b>	<b>Evaluate</b>

**Mapping of Course Outcomes to Program Outcomes:**

<b>CO/PO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO1</b>	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<b>CO2</b>	<b>3</b>	--	--	--	--	--	--	--	--	--	--	--	--	--
<b>CO3</b>	--	<b>3</b>	--	--	--	--	--	--	--	--	--	--	--	--
<b>CO4</b>	--	--	<b>3</b>	<b>3</b>	<b>3</b>	--	--	--	<b>2</b>	<b>2</b>	--	--	<b>2</b>	<b>2</b>

Weblinks and Video Lectures (e-Resources)	
1	<a href="https://www.youtube.com/watch?v=cACk47vp4m4">https://www.youtube.com/watch?v=cACk47vp4m4</a>
2	<a href="https://www.youtube.com/watch?v=aJKuM4U-eYg">https://www.youtube.com/watch?v=aJKuM4U-eYg</a>

### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Continuous Comprehensive Assessment (CCA)			
	IAT-1	IAT-2	CCA-1	CCA-2
	50 Marks	50 Marks	50 Marks	50 Marks
Remember	15	10	5	5
Understand	15	10	5	5
Apply	10	15	10	10
Analyse	10	15	5	5
Create			25	25

### CIE Course Assessment Plan

CO's	Marks Distribution						Total Marks	Weightage(%)
	Test-1			Test-2				
	Module-1	Module-2	Module 2 to 2.5	Module-2.5 to 3	Module-4	Module-5		
CO1	10	10	5	5	10	5	50	50
CO2	5	10	0	0	10	5	25	25
CO3	5	5	0	0	0	5	15	15
CO4	0	0	0	0	0	10	10	10
<b>Total</b>	<b>20</b>	<b>25</b>	<b>5</b>	<b>5</b>	<b>20</b>	<b>25</b>	<b>100</b>	<b>100</b>

### SEE- Semester End Examination (50 Marks)

Bloom's Category	SEE Marks
Understand	40
Apply	30
Analyse	20
Create	10

**SEE Course Plan**

<b>CO's</b>	<b>Marks Distribution</b>					<b>Total Marks</b>	<b>Weightage (%)</b>
	<b>Module-1</b>	<b>Module-2</b>	<b>Module-3</b>	<b>Module-4</b>	<b>Module-5</b>		
<b>CO1</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>5</b>	<b>45</b>	<b>45</b>
<b>CO2</b>	<b>10</b>	<b>5</b>	<b>0</b>	<b>10</b>	<b>10</b>	<b>35</b>	<b>35</b>
<b>CO3</b>	<b>0</b>	<b>5</b>	<b>5</b>	<b>0</b>	<b>10</b>	<b>20</b>	<b>20</b>
<b>CO4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>00</b>	<b>00</b>
<b>Total</b>	<b>20</b>	<b>20</b>	<b>15</b>	<b>20</b>	<b>25</b>	<b>100</b>	<b>100</b>



**Dayananda Sagar Academy of Technology & Management**  
(Autonomous Institute under VTU)

<b>Semester</b>	:	<b>7<sup>th</sup> Sem</b>		
<b>Course Title</b>	:	<b>Introduction to smart grid technology</b>		
<b>Course Code</b>	:	<b>BEE703D</b>		
<b>Course Type</b> (Theory/ Practical/ Integrated)	:	<b>Theory</b>		
<b>Category</b>	:	<b>Elective</b>		
<b>Stream</b>	:	<b>EEE</b>	<b>CIE</b>	: <b>50</b>
<b>Teaching hours/ week</b> (L:T:P:S)	:	<b>3:1:0:0</b>	<b>SEE</b>	: <b>50</b>
<b>Total Hours</b>	:	<b>40</b>	<b>SEE</b>	: <b>3</b>
<b>Credits</b>	:	<b>3</b>	<b>Duration</b>	

**Course Learning Objectives:** Students will be able to:

Sl. No	Course Objectives
1	To introduce the fundamentals, architecture, and components of smart grid systems.
2	To develop understanding of communication and measurement technologies used in smart grids.
3	To explain the role of next-generation grids and their impact on energy markets.
4	To provide knowledge on interoperability standards and cyber security challenges in smart grids.
5	To expose students to real-time case studies, testbeds, and recent smart grid implementations.

**Teaching-Learning Process**

**Pedagogical Initiatives:**

Some sample strategies to accelerate the attainment of various course outcomes are listed below:

- Include videos to demonstrate various concepts.
- Encourage collaborative (Group) Learning to encourage team building.
- Adopt **Problem-Based Learning (PBL)**, which fosters students' analytical skills, and develops thinking skills such as evaluating, generalizing, and analyzing information rather than simply

recalling it.

- Show different ways to solve a problem and encourage the students to come up with creative and optimal solutions.



**DSATM**

**Scheme of Teaching and Examinations for BE Programme -2024-25**

**Outcome Based Education and Choice Based Credit System (CBCS)**

**(Effective from the Academic Year 2024-25)**

**COURSE CURRICULUM**

<b>Module No.</b>	<b>Topics</b>	<b>Hours</b>
<b>1</b>	<b>MODULE 1: Smart Grid Architectural Designs</b> Conventional grid vs smart grid, Need for smart grid (energy, environment, economy), Definition and features of smart grid, Smart grid architecture and functions, Components: Smart devices, Storage systems, Transmission & distribution systems, Demand-side Management, Stakeholders and roles	<b>10</b>
<b>Pedagogy</b>		
<b>2</b>	<b>MODULE 2: Communication &amp; Measurement Technologies</b> Communication systems in smart grid, Measurement Technologies: Phasor Measurement Units (PMU), Wide Area Monitoring Systems (WAMS), Smart meters, Advanced Metering Infrastructure (AMI), Communication technologies for AMI Systems, Smart appliances, Multi-Agent Systems (MAS) basics, Microgrid vs Smart Grid	<b>10</b>
<b>Pedagogy</b>		
<b>3</b>	<b>MODULE 3: Next Generation Power Grids and its impact on Power/Energy Market:</b> Introduction, Market scenarios for different engineers, Self healing grid market, Blackout effect on power market, Big Data Analytics in Energy/power sector market,	<b>10</b>
<b>Pedagogy</b>		
<b>4</b>	<b>MODULE-4: Interoperability &amp; Cyber Security</b> Smart grid interoperability , Standards overview, Cyber security- Key Elements of Green Cybersecurity Cyber Physical Systems , Cyber Attacks- Cyber Physical System Architecture, Purpose of IT, IT & ICS, Cyber Attack Classifications, Attack Vectors on Power Grid, Attackers Perspective, DoS Attack , Intensity of Threat, Recent Cyber Attacks, Convergence of IT & OT, Best Practices.	<b>10</b>
<b>Pedagogy</b>		
	<b>MODULE-5: Case Studies and Testbeds for the Smart Grid</b> Introduction, Demonstration Projects, Microgrid with Renewable Energy ,Case	

<b>5</b>	Study of RER Integration, Testbeds and Benchmark Systems, Challenges 7 Benefits of Smart Transmission, Recent real time case study based on IEEE/Elsevier research papers.	<b>10</b>
<p><b>Pedagogical Initiatives (Not limited to):</b></p> <ul style="list-style-type: none"> <li>• <b>Think Pair and Share (Blended Learning):</b> provides an opportunity for students to learn from one another</li> <li>• <b>Problem Solving:</b> encourages cognitive thinking and enables creative problem solving</li> <li>• <b>Poster Presentation:</b> allows students to represent the concepts visually in order to understand the topics easily.</li> <li>• <b>Case studies:</b> maps different domains in real time applications</li> <li>• <b>Demonstration:</b> exhibits the implementation process</li> </ul>		

<b>Text Books</b>	
Sl. No.	Title of the Book/Name of the author/Name of the publisher/Edition and Year
1	<i>Smart Grid: Fundamentals of Design and Analysis</i> by Dr. James Momoh, published by Wiley-IEEE Press in 2012
<b>Reference Books</b>	
1	ISGF Materials: <a href="https://www.indiasmartgrid.org/">https://www.indiasmartgrid.org/</a>

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

CO	Course Outcomes	RBT Level	RBT Level Indicator
CO1	Explain the fundamentals, architecture, components, communication technologies, and operational concepts of smart grids, including their role in modern power systems and evolving	<b>L2</b>	<b>Understand</b>
CO2	Apply knowledge of smart grid technologies, measurement systems (PMU, AMI), and communication frameworks to describe real-	<b>L3</b>	<b>Apply</b>
CO3	Analyze the performance and behavior of smart grids, considering renewable integration, microgrids, market dynamics, and system reliability under different operating conditions.	<b>L4</b>	<b>Analyze</b>
CO4	Evaluate interoperability issues, standards, cyber security threats, and protection mechanisms in smart grid systems, considering real-world constraints and system integration challenges.	<b>L5</b>	<b>Create</b>

**Mapping of Course Outcomes to Program Outcomes:**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												2	2
CO3		3												
CO4			3		3			2	3	2			2	2

**CIE- Continuous Internal Evaluation (50 Marks)**

Bloom's Category	Continuous Comprehensive Assessment (CCA)			
	IAT-1	IAT-2	CCA-1	CCA-2
	50 Marks	50 Marks	50 Marks	50 Marks
Remember	15	10	5	5
Understand	15	10	10	10
Apply	10	10	5	5
Analyse	10	10	5	5
Create		10	25	25

**CIE Course Assessment Plan**

CO's	Marks Distribution						Total Marks	Weightage(%)
	Test-1			Test-2				
	Module-1	Module-2	Module 2 to 2.5	Module-2.5 to 3	Module-4	Module-5		
CO1	15	10	5	5	10	5	50	50
CO2	5	5	0	0	10	5	25	25
CO3	0	5	5	0	0	5	15	15
CO4	0	0	0	0	0	10	10	10
<b>Total</b>	<b>20</b>	<b>20</b>	<b>10</b>	<b>5</b>	<b>20</b>	<b>25</b>	<b>100</b>	<b>100</b>

**SEE- Semester End Examination (50 Marks)**

<b>Bloom's Category</b>	<b>SEE Marks</b>
<b>Understand</b>	<b>50</b>
<b>Apply</b>	<b>25</b>
<b>Analyse</b>	<b>15</b>
<b>Create</b>	<b>10</b>

**SEE Course Plan**

<b>CO's</b>	<b>Marks Distribution</b>					<b>Total Marks</b>	<b>Weightage (%)</b>
	<b>Module-1</b>	<b>Module-2</b>	<b>Module-3</b>	<b>Module-4</b>	<b>Module-5</b>		
<b>CO1</b>	<b>15</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>5</b>	<b>50</b>	<b>50</b>
<b>CO2</b>	<b>5</b>	<b>5</b>	<b>0</b>	<b>10</b>	<b>5</b>	<b>25</b>	<b>25</b>
<b>CO3</b>	<b>0</b>	<b>5</b>	<b>5</b>	<b>0</b>	<b>5</b>	<b>15</b>	<b>15</b>
<b>CO4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>10</b>	<b>10</b>	<b>10</b>
<b>Total</b>	<b>20</b>	<b>20</b>	<b>10</b>	<b>20</b>	<b>25</b>	<b>100</b>	<b>100</b>

**OPEN ELECTIVE  
COURSE  
(OEC)**

## **OEC – Open Elective Course**

Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator / Advisor / Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10. Project Phase – I: Students have to discuss with the mentor / guide and with their help he / she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

Teaching Hours/Week (L: T:P: S)	3:0:0:0
Total Hours of Pedagogy	40 hours – Theory
Credits:	03
Modules	5
CIE Marks	50
SEE Marks	50
Total Marks	100
Exam Hours	3
Examination nature (SEE)	Theory

### **3 Credit Course – Open Elective Course (OEC)**

Open Elective Courses (OEC): A open elective course (OEC) is a course offered by departments other than a student's parent department. These interdepartmental /interdisciplinary courses allow students to explore disciplines beyond their core area of study. These courses are intended to promote interdisciplinary learning, broad-based education, thereby enhancing a student's overall knowledge, creativity, and employability. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor/Proctor.

#### **Assessment Details (both CIE and SEE)**

- The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.
- The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).
- A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

#### **Continuous Internal Evaluation:**

#### **Internal Assessment Test (IAT):**

- For the Internal Assessment Test component of CIE, there are 25 marks and for Assignment component of the CIE, there are 25 marks. Two Tests, each of 50 Marks with 01-hour 30 minutes' duration, are to be conducted and average of two tests to be reduced to 25 marks
  - The first test will be administered after 40-50% of the syllabus has been covered, and
  - The second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

- Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

**The IA test questions are to be framed to map the Course Outcomes (COs), Program Outcomes (POs) and the Blooms RBT Levels. Emphasis to be given for higher order RBT levels**

#### **Semester-End Examination:**

Theory SEE will be conducted as per the scheduled timetable (duration 03 hours).

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks.

#### **Continuous and Comprehensive Assessment (CCA):**

Two of continuous and comprehensive assessment (CCA) to be conducted to attain COs and POs, evaluated each for **50 Marks**. Total Marks scored will be CCA1+CCA2 and scaled down to **10 Marks**.

- CCA1 after 4<sup>th</sup> week and CCA2 after 9<sup>th</sup> week. The evaluation includes either through quiz or rubrics
- CCA as project-based learning,
  - CCA is evaluated for **50 Marks** with review 1 of **20 Marks** after and review 2 of **30 Marks** includes project demonstration/competition and report submission.
  - The evaluation of review 1 after 6<sup>th</sup> weeks of semester and review 2 after 12<sup>th</sup> week of semester with project demonstration and submission of the report

Total score for CCA is **10 Marks**

Total Marks scored for theory component of CIE (IAT+ CCA) is **25 Marks**

#### **Possible Continuous and Comprehensive Assessment (CCA):**

- Project based, Problem Based, Building Models, Lab-to-Land, Mobile Studio, Design and Programming Contest, Certification, Concept Map (Collage presentation/poster presentation),

Case studies, Think-Pair-Share, Flipped classroom,

- The assessment of these techniques shall be in rubrics.
- The faculty can adopt any other CCA method of implementation and its assessment with prior approval of Program Assessment Committee (PAC).

**Open Elective Course (OEC) – 3 Credit course – Theory**

Assessment Method	Component	Type of Assessments	Syllabus Coverage	Maximum Marks	Average	Reduced Marks	Minimum Passing Marks	Evaluation Details
<b>Total CIE Theory + Practical</b>				<b>50</b>	----	----	<b>20</b>	
	<b>Theory</b>	Internal Assessment Test (IAT) - II	Module – 1 to 2.5	50	(50+50) / 2	<b>25</b>	10	Average of Two Internal test each of 50 Marks scale down the
		Internal Assessment Test (IAT) - II	Module – 2.5 to 5	50				
	<b>Continuous Comprehensive Assessment (CCA)</b>	CCA-1- Pedagogical Initiatives / Activity Based learning	Considering all the Modules	50	(50+50) / 2	<b>25</b>	10	Two CCA methods as per VTU Clause 22OB4.2 of regulations to be adopted. If CCA chosen is Project Based Learning, then one assessment method may be adopted
		CCA-2- Pedagogical Initiatives / Activity Based learning		50				
	<b>Total CIE Theory</b>						<b>50</b>	20

<b>SEE</b>		Theory exam	Entire theory syllabus including questions from lab Component in respective Modules	100	----	50	20	SEE Exam is theory Exam conducted for 100 Marks, scored Marks are scaled down to 50 Marks
<b>CIE + SEE</b>				100	----	----	40	



# Dayananda Sagar Academy of Technology & Management

(Autonomous Institute under VTU)

Semester	:	<b>VII</b>		
Course Title	:	<b>Energy Conservation and Audit</b>		
Course Code	:	<b>BEE704A</b>		
Course Type (Theory/ Practical/ Integrated)	:	<b>Theory</b>		
Category	:	<b>OEC</b>		
Stream	:	<b>EEE</b>	<b>CIE</b>	: <b>50</b>
Teaching hours/ week (L:T:P:S)	:	<b>03:0:0:0</b>	<b>SEE</b>	: <b>50</b>
Total Hours	:	<b>40</b>	<b>SEE</b>	: <b>3Hrs</b>
Credits	:	<b>03</b>	<b>Duration</b>	

**Course Learning Objectives:** Students will be able to:

Sl. No	Course Objectives
1	Understand energy scenario and general aspects of energy audit
2	Learn about methods and concept of energy audit
3	explain the parameters required for energy audit and the working of the instruments used in the measurement of the parameters

## Teaching-Learning Process

### Pedagogical Initiatives:

Some sample strategies to accelerate the attainment of various course outcomes are listed below:

- Adopt different teaching methods to attain the course outcomes.
- Include videos to demonstrate various concepts in C.
- Encourage collaborative (Group) Learning to encourage team building.
- Ask at least three **HOTS (Higher-order Thinking Skills)** module-wise questions to promote critical thinking.
- Adopt **Problem-Based Learning (PBL)**, which fosters students' analytical skills, and develops thinking skills such as evaluating, generalizing, and analyzing information rather than simply recalling it.
- Show different ways to solve a problem and encourage the students to come up with creative

and optimal solutions.

- Discuss various case studies to map with real-world scenarios and improve the understanding.
- Devise innovative pedagogy to improve **Teaching-Learning Process (TLP)**.



**DSATM**

## **Scheme of Teaching and Examinations for BE Programme -2026-27**

### **Outcome Based Education and Choice Based Credit System (CBCS)**

**(Effective from the Academic Year 2026-27)**

#### **COURSE CURRICULUM**

<b>Module No.</b>	<b>Topics</b>	<b>Hours</b>
<b>1</b>	<b>Energy Scenario:</b> Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.	<b>8</b>
<b>Pedagogy</b>	<b>Chalk and talk, Poster Presentation</b>	
<b>2</b>	<b>Energy Efficiency in Electrical Systems:</b> Electricity billing, Electrical load management and maximum demand Control, Maximum demand controllers; Power factor improvement, Automatic power factor controllers, efficient operation of transformers, energy efficient motors, soft starters, Variable speed drives; Performance evaluation of fans and pumps, Flow control strategies and energy conservation opportunities in fans and pumps, Electronic ballast, Energy efficient lighting and measures of energy efficiency in lighting system.	<b>8</b>
<b>Pedagogy</b>	<b>Chalk and talk, Presentation, videos</b>	
<b>3</b>	<b>Energy auditing:</b> Need of Energy audit, Types of energy audit, Energy management (audit) approach, understanding energy costs, Bench marking, Energy performance - Matching energy use to requirement Maximizing system efficiencies, Optimizing the input energy requirements, Duties and responsibilities of energy auditors, Energy audit instruments, Procedures and Techniques.	<b>8</b>
<b>Pedagogy</b>	<b>Chalk and Talk, NPTEL videos, Group Discussion, Case studies</b>	
<b>4</b>	<b>Electrical Energy Management:</b> Supply side Methods to minimize supply-demand gap -Renovation and modernization of power plants, Reactive power management - Demand side - Conservation in motors, Pumps and fan systems, Energy efficient motors.	<b>8</b>

	<b>Thermal Energy Management:</b> Energy conservation in boilers - steam turbines and industrial heating systems - Application of FBC - Cogeneration and waste heat recovery	
<b>Pedagogy</b>	<b>Group Discussion, Case studies</b>	
<b>5</b>	<b>Energy Audit of Lighting Systems:</b> Fundamentals of Lighting, Different Lighting Systems, Ballasts, Fixtures (Luminaries), Reflectors, Lenses and Louvres, Lighting Control Systems, Lighting System Audit, Energy Saving Opportunities. <b>Energy Audit Applied to Buildings:</b> Energy – Saving Measures in New Buildings, Water Audit, Method of Audit, General Energy – Savings Tips Applicable to New as well as Existing Buildings.	<b>8</b>
<b>Pedagogy</b>	<b>Group Discussion, Case studies Poster Presentation</b>	

<b>Text Books</b>	
<b>Sl. No.</b>	<b>Title of the Book/Name of the author/Name of the publisher/Edition and Year</b>
<b>1</b>	Handbook on Energy Audit Sonal Desai Mc Graw Hill 2015
<b>2</b>	Energy Management, W. R. Murphy & G. McKay.
<b>Reference Books</b>	
<b>1</b>	Energy Conservation Handbook, Frank Kreith.
<b>2</b>	Energy Conservation Diwan, P. Pentagon Press (2008)

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

<b>CO</b>	<b>Course Outcomes</b>	<b>RBT Level</b>	<b>RBT Level Indicator</b>
<b>CO1</b>	Understand the basic concepts of energy audit, energy management and learn energy audit procedures, techniques and usage of energy audit instruments.	<b>L2</b>	<b>Understanding</b>
<b>CO2</b>	Apply the knowledge to identify energy saving potential of thermal and electrical systems for maximizing and optimizing system	<b>L3</b>	<b>Apply</b>
<b>CO3</b>	Analyse energy management systems, prepare and present energy audit reports	<b>L4</b>	<b>Analyze</b>
<b>CO4</b>	Construct a report on energy audit of a classroom/laboratory	<b>L5</b>	<b>Evaluate</b>

### Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3		3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	-	3	3	-	2	2	-	-	-	-	-

### Weblinks and Video Lectures (e-Resources)

1	<a href="https://www.youtube.com/watch?v=BrBBneXpIjk&amp;list=PL7xNNm8fw3l-aQsf18Etr_BqVebOuHlsy">https://www.youtube.com/watch?v=BrBBneXpIjk&amp;list=PL7xNNm8fw3l-aQsf18Etr_BqVebOuHlsy</a>
2	<a href="https://www.youtube.com/watch?v=xxe1uS0sknE">https://www.youtube.com/watch?v=xxe1uS0sknE</a>
3	<a href="https://www.youtube.com/watch?v=aVdvc_if6Zc">https://www.youtube.com/watch?v=aVdvc_if6Zc</a>
4	<a href="https://www.youtube.com/watch?v=Ua3kZfxFL84">https://www.youtube.com/watch?v=Ua3kZfxFL84</a>

### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Theory			
	Continuous Assessment Tests (IAT)		Continuous Comprehensive Assessment (CCA)	
	IAT-1	IAT-2	CCA-1	CCA-2
	50 Marks	50 Marks	50 Marks	50 Marks
Remember	10	10	-	-
Understand	15	20	-	-
Apply	25	10	20	10
Analyse	-	10	20	20
Evaluate	-	-	10	20

## CIE Course Assessment Plan

CO's	Marks Distribution						Total Marks	Weightage
	Test-1			Test-2				
	Module-1	Module-2	Module 2 to 2.5	Module-2.5 to 3	Module-4	Module-5		
CO1	10	10	5	5	15	10	55	55
CO2	10	10	5	5	5	-	35	35
CO3	-	-	-	-	-	10	10	10
CO4	-	-	-	-	-	-	-	-
<b>Total</b>	<b>20</b>	<b>20</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>20</b>	<b>100</b>	<b>100</b>

**CAPSTONE PROJECT**  
**(Phase-1)**

## CAPSTONE PROJECT (Phase-1 & 2):

### Capstone Project – Guidelines & Implementation Framework (UG Engineering Programs)

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#### 1. Introduction

The Capstone Project is a comprehensive, year-long project carried out in **two phases during the 6th and 7th semesters** of the undergraduate engineering/technology program. It integrates knowledge and skills acquired from multiple courses and disciplines to address a **complex, real-world problem**.

This project provides students with an opportunity to apply:

- Scientific principles
- Engineering methodologies
- Technological tools

to **conceive, design, implement, and evaluate an engineering solution**.

The Capstone Project serves as a **culminating academic experience** enabling students to demonstrate attainment of program outcomes including:

- Problem-solving ability
- Teamwork
- Communication skills
- Practical application of engineering principles

Students may undertake the project:

- Individually, OR
- In a group **not exceeding four students**

The group may include:

- Students from the same discipline
- Students drawn from different disciplines

#### 2. Types of Capstone Projects

Capstone projects undertaken during the one-year duration may fall into one or more of the following categories:

##### a) **Research-Oriented Projects**

- Focus on investigating new concepts, theories, or technologies.
- Aim to generate new knowledge or contribute to academic research.

**b) Experimental / Analytical Projects**

- Based on laboratory or field experiments to validate a hypothesis or study a phenomenon.
- Include detailed data collection, analysis, and interpretation.

**c) Simulation / Modelling Projects**

- Use computational tools to model, simulate, and predict system behaviour.
- Reduce the need for physical prototyping in the initial stages.

**d) Industrial / Industry-Sponsored Projects**

- Carried out in collaboration with an industry partner.
- Address real-world engineering problems faced by the organization.

**e) Interdisciplinary / Multidisciplinary Projects**

- Combine knowledge and techniques from multiple engineering domains.
- May also involve other fields such as:
  - Management
  - Medicine
  - Environmental sciences

**f) Entrepreneurial / Innovation Projects**

- Focus on product or service innovation with potential for commercialization.
- Include:
  - Market analysis
  - Cost estimation
  - Business planning

### **3. Objectives of the Capstone Project**

The objectives of the Project Work are:

1. To encourage independent learning and an innovative attitude among students.
2. To develop interactive attitude, communication skills, organization, time management, and presentation skills.
3. To impart flexibility and adaptability.
4. To inspire teamwork.
5. To expand intellectual capacity, credibility, judgment, and intuition.
6. To ensure adherence to punctuality and meeting deadlines.
7. To instill responsibility towards oneself and others.
8. To train students to present project work confidently in seminars, enhance communication skills, and participate in discussions to exchange ideas.

### **4. Capstone Project – Phase I Evaluation**

Capstone Project Phase-I shall have **Continuous Internal Evaluation (CIE) only**.

#### **4.1 Evaluation Committee – Single Discipline Project**

The Departmental Project Review Committee shall consist of:

- One Senior Professor
- Project Guide
- One additional faculty member appointed by the Principal

#### **4.2 Evaluation Committee – Interdisciplinary Project**

The Project Review Committee shall consist of:

- One Senior Professor
- Department Project Guide
- Interdepartmental Project Guide(s)
- One faculty member from a related department

All members shall be appointed by the Principal.

### **4.3 Evaluation Criteria**

Phase-I evaluation shall be based on:

- Rubrics designed to measure **NBA Graduate Attributes**

Successful completion of Phase-I allows the student to proceed to **Phase-II**.

## **5. Capstone Project – Phase II Evaluation**

### **5.1 Continuous Internal Evaluation (CIE)**

CIE for Phase-II shall be conducted similarly to Phase-I using the designated committee.

### **5.2 Semester End Examination (SEE)**

The SEE shall be conducted by:

- **University-appointed examiners**

Assessment shall be based on:

- Rubrics designed to measure **NBA Graduate Attributes**

## **6. Continuous Internal Evaluation (CIE) Procedure**

### **6.1 Single Discipline Project**

The CIE marks shall be awarded by a committee consisting of:

- Head of the concerned Department
- Two senior faculty members of the Department
- One of the two faculty members shall be the Project Guide

### **6.2 Distribution of CIE Marks**

The CIE marks for the project work shall be based on:

<b>Component</b>	<b>Weightage</b>
Project Report	50%
Project Presentation Skill	25%
Question & Answer Session	25%

**Non-Credit Mandatory Courses (NCMC):** are aimed at enhancing students' knowledge, skills, and awareness beyond the core curriculum. Successful completion of the NCMC is compulsory for fulfilling the requirements of the academic program. It shall not be considered for the computation of SGPA, CGPA and vertical progression. Each student shall register for the prescribed NCMC(s) in the prescribed semester. A student who fails to qualify in the prescribed NCMC shall not be eligible for the conferment of the degree.

### **AICTE Activity Points**

Apart from technical knowledge and skills, to be successful as professionals, students should have excellent soft skills, leadership qualities and team spirit. They should have entrepreneurial capabilities and societal commitment. To match these requirements, AICTE has created a unique mechanism of awarding minimum 100 Activity Points for regular students and 75 Activity Points for Lateral Entry students over and above the academic grades.

The activities can be spread over the entire duration of the programme and will be reflected in the Student's VIII Semester Grade Card. It shall not be considered for computation of SGPA/CGPA and for vertical progression. The total duration of the activities for the entire programme is 320 hours for regular students and 240 hours for lateral entry students.

Break-up of CCE marks for activity points:

Evaluation by the Proctor/Coordinator 50 marks

Evaluation by the Dept. Committee

(i) Report 20 marks

(ii) Presentation 20 marks

(iii) Outcome 10 marks

Total 100 marks

1. No SEE for AICTE Activity Points.

2. Students will be awarded either NP or P grade based on marks obtained.

Students will be awarded 'Degree' only on earning P grade in the Activity Points.

**8<sup>th</sup> SEMESTER**

## **Projects**

**1. Community Project:** A community is a social unit or group of people sharing socially-significant characteristics, such as place, set of norms, culture, religion, values, customs or identity. A community project involves addressing issues or needs within such a community or a network of entities working toward a common purpose. These projects may cover a wide range of areas, including welfare, sustainability, technology integration, and social development. Examples include establishing and maintaining an orphanage, implementing solar power generation and its maintenance, or developing environmental improvement solutions, etc. A community project is an experiential learning activity that encourages students to identify, analyse, and address real-life problems of the community using engineering knowledge. It aims to promote social responsibility and civic engagement, interdisciplinary thinking and collaboration and practical application of theoretical concepts, thereby enabling students to contribute meaningfully to community welfare and sustainable development. Students can take up project individually or in a group not exceeding 4 students.

The evaluation shall be done as per the following; CIE: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work shall be based on the rubrics. SEE: SEE will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the rubrics.

## **2. Environmental Science Project:**

The Environmental Science Project is an applied learning component designed to develop students' awareness, understanding, and responsibility toward the environment. It provides an opportunity to study real-world environmental issues and apply scientific and engineering principles to design feasible and sustainable solutions. The topics under environment include, but not limited to, climate change, biodiversity, air and water pollution, land use, excess use of natural resources, earthquakes, rise in the earth's temperature, power generation, soil erosion, environment issues related programme, etc. The project involves problem identification, field surveys, case studies, data collection, environmental audits, analysis, and proposal of remedial or preventive measures aimed at improving biodiversity, air quality, and

thermal comfort, etc. Students can take up project individually or in a group not exceeding 4 students. Students can opt for Interdisciplinary Project based on their interest.

The evaluation shall be done as per the following; CIE: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the rubrics. SEE: SEE will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the rubrics.

### **3. Hackathon Based Project (Academic):**

The term hackathon is derived from the combination of hack (referring to clever problem-solving, not illegal activity) and marathon, which denotes an arduous (i.e., difficult) intellectual task requiring sustained effort, endurance, and mental resilience. The meaning of a hackathon varies depending on the specific context and intent. In an academic context, a hackathon can be considered to involve several concepts, ranging from resourceful, unconventional approaches to problem-solving. Though a hackathon is an event, typically lasting for a few days to address a specific challenge, for academic purposes, it is conducted as a noncompetitive semester-long activity. The evaluation is done as and when the project is completed, by a panel of industry experts. The hackathons not only help participants develop skills like problem-solving, critical thinking, creativity, teamwork, communication and time management, but also foster indigenous technology development, promote innovation and entrepreneurship, and contribute to non-formal learning and skill enhancement. Students can take up a hackathon project individually or in a group of not exceeding 4 students.

The respective BoS will announce the problem statements in the beginning of the 5th semester. The topic selected can be discipline specific, interdepartmental, industrial, social (refers to immediate human relations, interactions, and individual behaviour within a community), societal (describes larger, general issues, institutions, and structures that define society as a whole), environmental, health, financial, or innovative in nature, leading to development of a working prototype, application, or product. Hackathon projects are aligned with the principles of Outcome-Based Education (OBE) and support the objectives of innovation, skill development, and experiential learning in engineering education. Projects shall be evaluated by industry experts, based on creativity, problem-solving approach, teamwork, and possible implementation, as far as possible, as and when the project is

completed. The evaluation shall be done as per the following; CIE: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the rubrics. SEE: SEE will be conducted by the industry experts appointed by the Head of the Institute/University. The SEE marks awarded for the project work shall be based on the rubrics.

#### **4. Capstone Project :**

The Capstone project is a comprehensive, year-long project carried out in two phases during 6th and 7th semesters of the undergraduate engineering/technology program. It integrates knowledge and skills acquired from multiple courses and disciplines to address a complex, real-world problem. This project provides students with an opportunity to apply scientific principles, engineering methodologies, and technological tools to conceive, design, implement and evaluate an engineering solution. It serves as a culminating academic experience to demonstrate program outcomes, including problem-solving ability, teamwork, communication skills, and practical application of engineering principles. Students can take up project individually or in a group not exceeding 4 students. The group may have students from the same discipline and drawn from different disciplines.

Types of Capstone Projects: Capstone projects undertaken for one year may fall into one or more of the following categories:

- a) Research-Oriented Projects :
  - Focus on investigating new concepts, theories, or technologies.
  - Aim to generate new knowledge or contribute to academic research.
- b) Experimental/Analytical Projects
  - Based on laboratory or field experiments to validate a hypothesis or study a phenomenon.
  - Including detailed data collection, analysis, and interpretation.
- c) Simulation/Modelling Projects
  - Use computational tools to model, simulate, and predict system behaviour.
  - Reduce the need for physical prototyping in the initial stages.
- d) Industrial/Industry-Sponsored Projects
  - Carried out in collaboration with an industry partner.

- Address real-world engineering problems faced by the organization.

e) Interdisciplinary/Multidisciplinary Projects

- Combine knowledge and techniques from multiple engineering domains or other fields such as management, medicine, or environmental sciences.

f) Entrepreneurial/Innovation Projects

- Focus on product or service innovation with potential for commercialization.
- Include aspects of market analysis, cost estimation, and business planning.

**Phase I Evaluation:** Capstone Project Phase-I shall have only Continuous Internal Evaluation (CIE). In case disciplinary capstone project, the CIE shall be conducted by the Departmental Project Review Committee, which consists of a Senior Professor, the Project Guide, and one additional faculty member appointed by the principal for projects within the parent discipline. For Interdisciplinary Projects, the Project Review Committee will consist of one Senior Professor, the department and interdepartmental Project Guides and one faculty member from a department related to the interdisciplinary project. The committee members are appointed by the principal of the college.

**Phase-I evaluation** shall be based on rubrics designed to measure graduate attributes defined by NBA. Successful completion of Phase-I allows the student to proceed to Phase-II.

**Phase II Evaluation:** CIE of Phase shall be evaluated as indicated with phase -I evaluation. The SEE shall be conducted by university-appointed examiners. The assessment shall be based on rubrics designed to measure graduate attributes defined by NBA.

Note: One Publication indexed in Scopus or Web of Science is Mandatory from Students Projects

## **Internship**

Internship refers to the position of a student as trainee or a temporary (or unconfirmed) employee, who works in an organization, with or without pay, in order to gain work experience or satisfy requirements for a qualification. It is a structured, supervised professional experience in an industry, research organization, or community setting. Students taking up internship may be with or without stipend. Internships play a vital role in bridging the gap between theoretical education and professional practice. In general, engineering internships serve as a crucial component of professional education by providing experiential learning, industry readiness, and holistic skill development, ultimately producing competent engineers or entrepreneurs. Apart from these, it develops professional ethics, work culture awareness and communication skills. Some of the common types of internships are as follows:

- i. **Industry Internship:** Carried out in the engineering industry, companies, manufacturing units, startups, business, IT industry. The topic involved may be technical, managerial, production-related tasks, live projects, or innovative activities.
- ii. **Research Internship:** Carried out at universities, research labs, or R and D departments or organisations. The internship may involve literature review, data analysis, and experimental work leading to publications, prototypes, technical reports or innovations. The research internship may induce students to plan for higher studies or academic careers.
- iii. **Academic or Teaching Internship:** Carried out at educational institutions. The students assist in academic activities, laboratory sessions or content development, and prepare or present report, presentation and student evaluation. The internship encourages interest in academia and pedagogy, develops new skills, helps to gain a competitive edge on the job market or for post-baccalaureate studies.
- iv. **Community or Societal Internship:** Carried out with government schemes, or rural development projects, Non-Governmental Organisations (NGOs). The internship focused on social and community development activities promotes social responsibility, sustainable development awareness, encourages civic responsibility and ethical engagement.

- v. **Entrepreneurship Internship:** Undertaken in association with start-ups, or entrepreneurship cells or launching own idea in Preincubations/Incubation centres. The internship offers exposure to business planning, prototype product development, and promotes innovation, risk-taking, and entrepreneurial mindset.
- vi. **Virtual or Remote or Online Internship:** Undertaken using online tools and digital collaboration platforms. Such internships are common in content writing, data science, marketing, and software development. It offers flexible learning environments and access to global opportunities, and allows participation in real projects without being physically present, from anywhere and anytime.
- vii. **Government Internship:** Ministries, public sector units, or civic bodies offer such internships in policy research, administrative tasks, or public service projects. This internship is for students interested in governance or public administration.
- viii. **Post-Placement Internship:** Refers to the internship offered to students after they receive a confirmed job offer (placement) from a company, but before formally joining as full-time employees. This internship (on-site, virtual, or hybrid) ensures that students are groomed to be professionally ready, technically competent, and culturally aligned with the organization even before official induction.
- ix. **Skill Enhancement Internship:** Carried out at reputed organisations in offline or online mode. The aim of the internship is to expose to real-world tools, technologies, and professional environments to improve a student's employability by offering hands-on experience, application of theoretical concepts, and skill development aligned with current industry and technical trends. Skill Enhancement Internships, depending on focus area and scope, can be carried out at various organisations such as, Academic and Research Institutions, Industry and Corporate Settings, Government and Public Sector, NGOs and Social Enterprises. For Skill Enhancement Internship topics refer to <https://online.vtu.ac.in/category/courses/Skill-Enhancement-Course>.

#### Note on Internship for the Attention of Students and Colleges

- Placement training conducted at the college level, whether by third-party agencies, training institutes, or internal faculty, shall not be considered as internship for either a 15 week or a 30-week period.

The official engagement period of 15-week or 30-week for students selected/recruited by the company/ organization only at their premises under the supervision of the company, shall only be considered as an internship.

- The period of training and working of students who have been recruited as employees by organisations at the beginning of the 4th year of the programme, shall also be treated as an internship.
- Students and colleges/institutions shall follow all the guidelines and procedures of the organization and the University's Internship Guidelines, and complete the internship within a period that matches with the VTU Calendar and examination timetable.
- The assigned institution faculty mentor/ coordinator/guide should monitor the student's progress, and document offer letters, training reports, attendance, and evaluations for awarding academic credits.
- All students undergoing an internship, should adhere to all the guidelines, reporting protocols, and evaluation procedures prescribed by the University.
- Students must submit the certificate of completion of an internship with the period of internship clearly mentioned, from the respective company/organization.
- Colleges must submit details of students opting for internship during the odd and even semesters, along with a copy of the company selection letter, to the VTU when notified by the University.

**Attention:** In addition to the internship support provided by the college, students have the option to select internships through the AICTE and VTU Internship Portals. To ensure uniformity, quality, and transparency in the internship process, VTU has developed a dedicated web portal that serves as a single platform where colleges can also register companies offering internships. Every student is required to register on the portal before the commencement of their internship, and their progress will be monitored through the same platform.

As per VTU norms, the CIE shall be conducted based on the students' performance during the training program, assessed through rubrics from the company supervisor. The SEE

evaluation shall be conducted by the college as per the examination timetable published by the VTU.

## **AICTE Activity Points**

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