Name of Institute: Indus Institute of Technology & Engineering

Name of Faculty:

Course code: EL0718

Course name: Advanced Power Electronics

Pre-requisites:

- Basics of Power Electronics
- Control system

Credit points: 03

Offered Semester: VII

Course coordinator (weeks 01 - 15)

Full name:

Department with siting location: 3rd floor, Bhawar Building

Telephone:

Email:

Consultation times: 4:00 p.m. to 5:00 p.m.

Course lecturer (weeks 01 - 15)

Full name:

Department with siting location: 3rd floor, Bhawar Building

Telephone:

Email:

Consultation times: 4:00 p.m. to 5:00 p.m.

Students will be contacted throughout the session via mail with important information relating to this course.

Course Objectives

- The student can identify different areas power conversion and related topology.
- Can find the applications of power electronics in day to day life.

Course Outcomes (CO)

CO-1:To impart knowledge of power semiconductor technologies and their advancement in the field of power conversion. [BT-1 & 2]

CO-2:To address the underlying concepts and methods behind Advanced Power Electronics [BT-2 & 3]

CO3:Analyze and design resonant converters [BT-2, 4 & 5]
CO4: Develop power converter models under steady state and small signal conditions [BT-4 & 6]

CO5: Design feedback control systems for power converters [BT-2 & 4]
CO6: Synthesize and design magnetic components for power converters [BT-2 & 4]

Method of delivery

Face to face lectures, Assignments, Quiz

Study time

Theory of 3 hours

CO-PO Mapping (PO: Program Outcomes)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	2										
CO2	3	3		2								
CO3	2	1	2	1	1							
CO4	1	2	1	1								
CO5	3		1									
CO6	3		1		1							

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

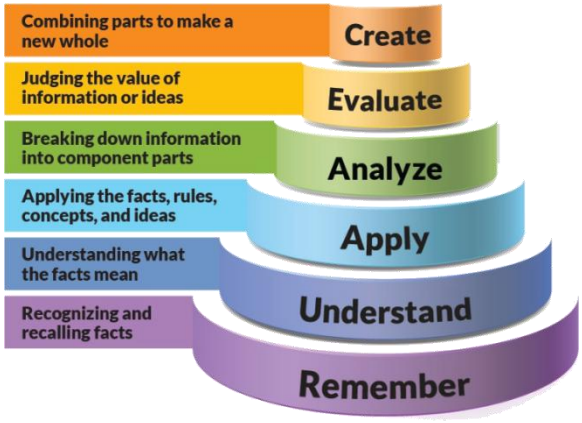

Figure 1: Blooms Taxonomy

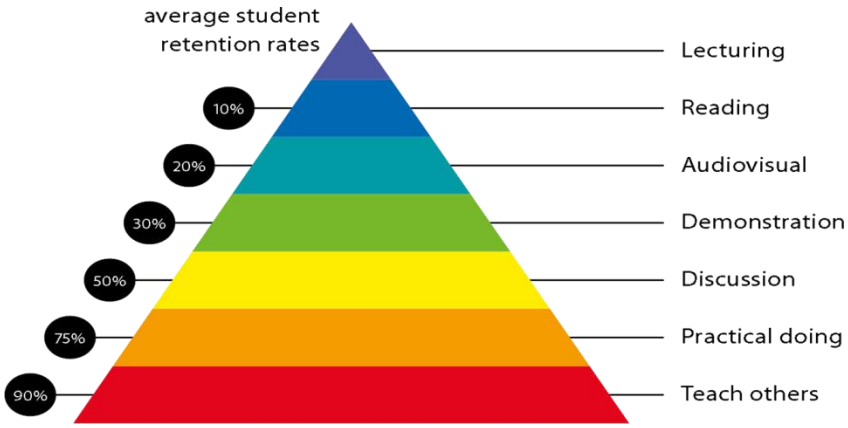

Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply	**1 Professional knowledge, grounding & awareness**

this knowledge. Understand how an area of study has developed and how it relates to other areas.	
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

Lecture/tutorial times

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

Details of referencing system to be used in written work

Text books

1. N. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics, Converter, Application and Design”, Third Edition, John Willey & Sons, 2004
2. M. H. Rashid, “Power Electronics, circuits, Devices and Applications”, Pearson, 2002, India.
3. K. Billings, “Switch Mode Power Supply Handbook”, McGraw-Hill, 1999, Boston

Additional Materials

1. B. K. Bose, “Power Electronics and Variable Frequency Drive”, Standard Publishers Distributors, 2000.
2. Bin Wu, “High-Power Converters and AC Drives”, IEEE Press, A John Wiley & Sons, Inc Publication , New York, 2006.

Web resources

1. https://nptel.ac.in/syllabus/syllabus_pdf/108102006.pdf
2. http://www.nitc.ac.in/electrical/ipg/pegcres/presentations/3%20Dr.%20Rijil%20Ramachand/01_Introduction%20to%20Multilevel%20Inverters.pdf
3. http://webfiles.portal.chalmers.se/et/MSc/DerakhshanfarMSc.pdf
4. http://shodhganga.inflibnet.ac.in/bitstream/10603/16448/7/07_chapter%202.pdf

MOOCs

1. https://www.edx.org/
2. https://www.nptel.ac.in/

3. https://www.coursera.org/

SSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

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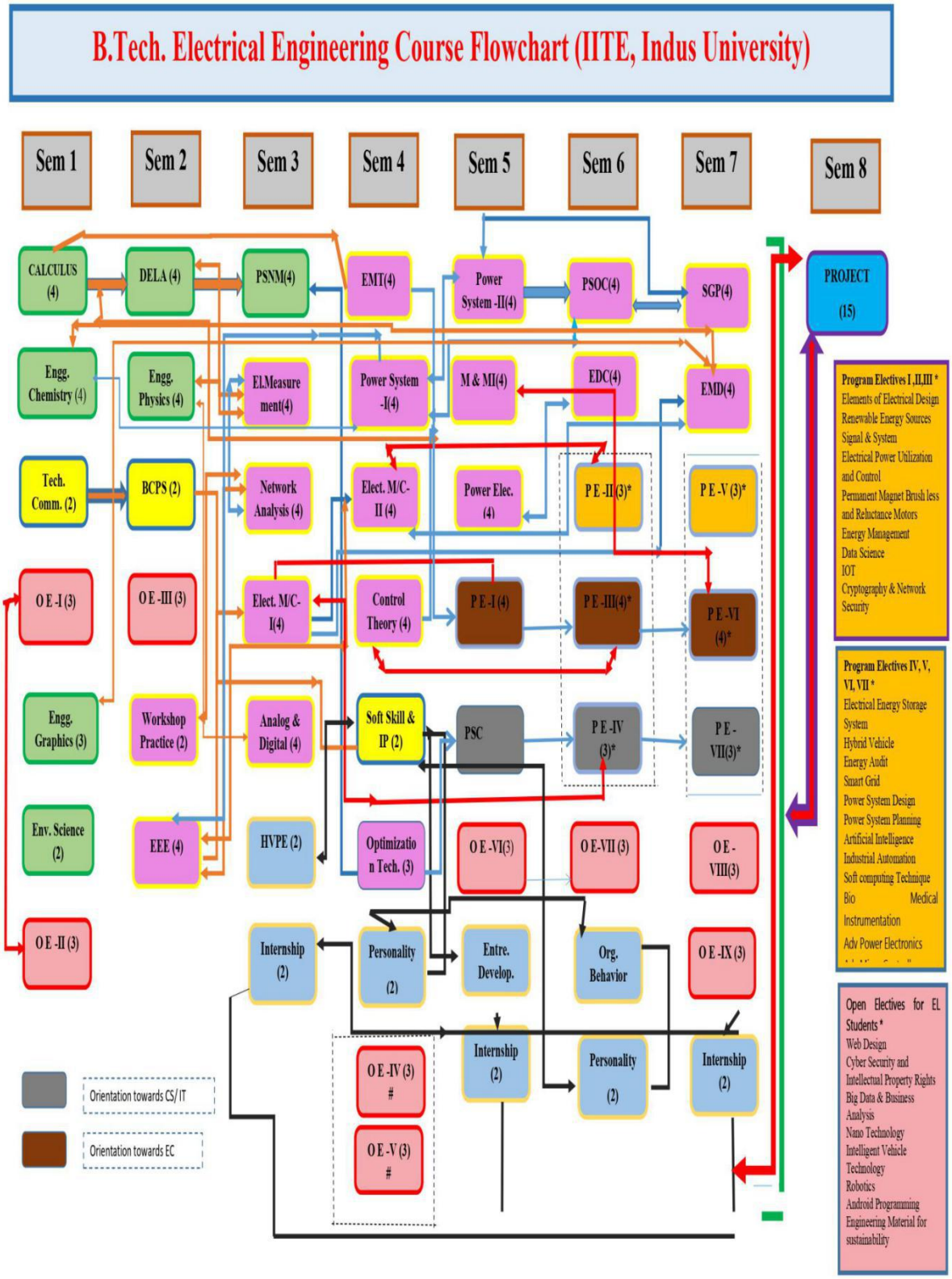
Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Introduction-Working principle, 1-ph to 1-ph – step up cycloconverter, midpoint, bridge type cycloconverter, 1-ph to 1-ph – step down cycloconverters, midpoint, bridge type cycloconverters,	2	BB
	Week 2	Introduction-Working principle, 1-ph to 1-ph – step up cycloconverter, midpoint, bridge type cycloconverter, 1-ph to 1-ph – step down cycloconverters, midpoint, bridge type cycloconverters,	2	BB
	Weeks 3	Three phase half wave cycloconverters - 3-ph to 1-ph cycloconverters, 3-ph to 3-ph cy**clocon**verters, output voltage equation for a cycloconverter, load commutated cycloconverter.	2	BB
	Week 4	**Multi-pulse converters :** Concept of multi-pulse, Multipulse Diode and SCR Rectifiers- review of 6 pulse, 12 pulse and 18 pulse rectifiers, multi level VSC.	1	BB
	Week 5	Introduction, Classification of resonant converters, basic resonant circuit concepts, load resonant converters, resonant switch converters, zero-voltage switching, clamped voltage	1	BB

		topologies,		
	Week6	Introduction, Classification of resonant converters, basic resonant circuit concepts, load resonant converters, resonant switch converters, zero-voltage switching, clamped voltage topologies,	*1*	BB
	Week7	resonant dc link inverters with zero voltage switching, high-frequency-link integral-half-cycle converters.	1	BB
	Week 8	resonant dc link inverters with zero voltage switching, high-frequency-link integral-half-cycle converters.		BB
	Week 9	Need for multi-level inverters, Concept of multi-level Cascaded Multi-level Inverter, Operation with equal and unequal DC sources, Carrier based PWM Control Strategy Diode Clamped multi-level inverter, configurations,	2	BB
	Week 10	Space Vector Modulation, Even Order Harmonic Elimination, Effect on Neutral Point Voltage Regulation of Neutral Point Voltage, Carrier Based Control Schemes ; Other Multilevel Inverter Configurations like Flying Capacitor,		BB
	Week 11	Space Vector Modulation, Even Order Harmonic Elimination, Effect on Neutral Point Voltage Regulation of Neutral Point Voltage, Carrier Based Control Schemes ; Other Multilevel Inverter Configurations like Flying Capacitor,		BB
	Week 12	PC-Hybrid etc. Features and relative comparison of these configurations and Applications		BB

	Week 13	Application of Switch mode DC power supplies, review of non-isolated dc-dc converters, need of isolation, classification of transformer based-isolated DC-DC converters, Fly-back converter, forward		BB
	Week 14	converter, full-bridge converter, half-bridge and push-pull converter, practical considerations.		BB
	Week 15	**Uninterruptible power supplies**-online, offline UPS, static switches-single phase ac switches, dc switches, solid state relays - DC solid state relays, AC solid state relays.		BB


B.Tech. Electrical Engineering Course Flowchart (IITE, Indus University)
Sem 1
Sem 2
Sem 3
Sem 4
Sem 5
Sem 6
Sem 7
Sem 8
CALCULUS (4)
DELA (4)
PSNM(4)
EMT(4)
Power System -II(4)
PSOC(4)
SGP(4)
PROJECT (15)
Engg. Chemistry (4)
Engg. Physics (4)
EL.Measurement(4)
Power System -I(4)
M & MI(4)
EDC(4)
EMD(4)
Tech. Comm. (2)
BCPS (2)
Network Analysis (4)
Elect. M/C-II (4)
Power Elec. (4)
P E -II(3)*
P E -V (3)*
O E -I (3)
O E -III (3)
Elect. M/C-I(4)
Control Theory (4)
P E -I (4)
P E -III(4)*
P E -VI (4)*
Engg. Graphics (3)
Workshop Practice (2)
Analog & Digital (4)
Soft Skill & IP (2)
PSC
P E -IV (3)*
P E - VII(3)*
Env. Science (2)
EEE (4)
HVPE (2)
Optimization Tech. (3)
O E -VI(3)
O E-VII (3)
O E - VIII(3)
O E -II (3)
Internship (2)
Personality (2)
Entre. Develop.
Org. Behavior
O E -IX (3)
Internship (2)
Personality (2)
Internship (2)
O E -IV (3) #
O E -V (3) #
Orientation towards CS/ IT
Orientation towards EC
Program Electives I ,II,III *
Elements of Electrical Design
Renewable Energy Sources
Signal & System
Electrical Power Utilization and Control
Permanent Magnet Brush less and Reluctance Motors
Energy Management
Data Science
IOT
Cryptography & Network Security
Program Electives IV, V, VI, VII *
Electrical Energy Storage System
Hybrid Vehicle
Energy Audit
Smart Grid
Power System Design
Power System Planning
Artificial Intelligence
Industrial Automation
Soft computing Technique
Bio Medical Instrumentation
Adv Power Electronics
Open Electives for EL Students *
Web Design
Cyber Security and Intellectual Property Rights
Big Data & Business Analysis
Nano Technology
Intelligent Vehicle Technology
Robotics
Android Programming
Engineering Material for sustainability

Name of Institute: Indus Institute of Technology & Engineering

Name of Faculty:

Course code: EL0731

Course name: Biomedical Instrumentation

Pre-requisites:

I) To have the basic knowledge about the principles behind sensors and transducers.

Ii) To have the knowledge about Operational Amplifiers

Iii) To have the basic knowledge about the working principles of various measuring instruments

Credit points: 03

Offered Semester: VII

Course coordinator (weeks 01 - 15)

Full name:

Department with siting location: 3rd floor, Bhawar Building

Telephone:

Email:

Consultation times: 4:00 p.m. to 5:00 p.m.

Course lecturer (weeks 01 - 15)

Full name:

Department with siting location: 3rd floor, Bhawar Building

Telephone:

Email:

Consultation times: 4:00 p.m. to 5:00 p.m.

Students will be contacted throughout the session via mail with important information relating to this course.

Course Objectives

- To impart knowledge of the principle of operation and design of biomedical instruments.
- To render a broad and modern account of biomedical instruments.
- To introduce idea about human physiology system

Course Outcomes (CO)

CO-1: Students will be able to understand the bioelectric potentials,the electrode theory, different types of electrodes and transducers. [BT-1 & 2]

CO-2: Students can understand and explain the working and concepts of ECG,EMG,EEG, plethysmography, impedance cardiology, cardiac arrhythmia's, pace makers, defibrillators [BT-2 & 3]

CO3: Students will be able to explain pulmonary measurements, respiratory rate measurement, artificial respirator, oximeter, hearing aids, functional neuromuscular simulation, physiotherapy, diathermy, nerve stimulator, artificial kidney machine. [BT-2, 4 & 5]

CO4: Students are able to understand Patient monitoring systems, patient monitoring through bio-telemetry, Sources of electrical hazards and safety techniques [BT-4 & 6]

CO5: Students are able to understand and analyze Clinical Flame photometer ,spectrophotometer ,Colorimeter,chromatography, Blood Gas Analyz, Blood pH Measurement, Blood Cell Counters [BT-2 & 4]

CO6: Students are able to understand and explain Medical imaging, Xrays, laser applications, ultrasound scanner, echo cardiography, CT Scan MRI/NMR, cine angiogram, colour doppler systems, Holter monitoring, endoscopy. [BT-2 & 4]

Method of delivery

Face to face lectures, Assignments, Quiz

Study time

Theory of 3 hours

CO-PO Mapping (PO: Program Outcomes)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3											
CO2	3											
CO3		2		1								
CO4		2		1								
CO5	3		1									
CO6	3		1									

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

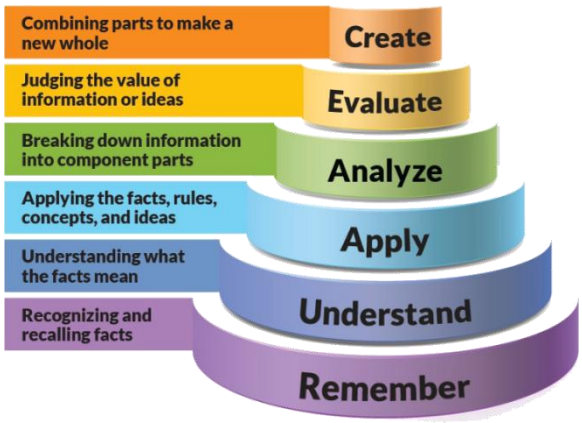


Figure 1: Blooms Taxonomy

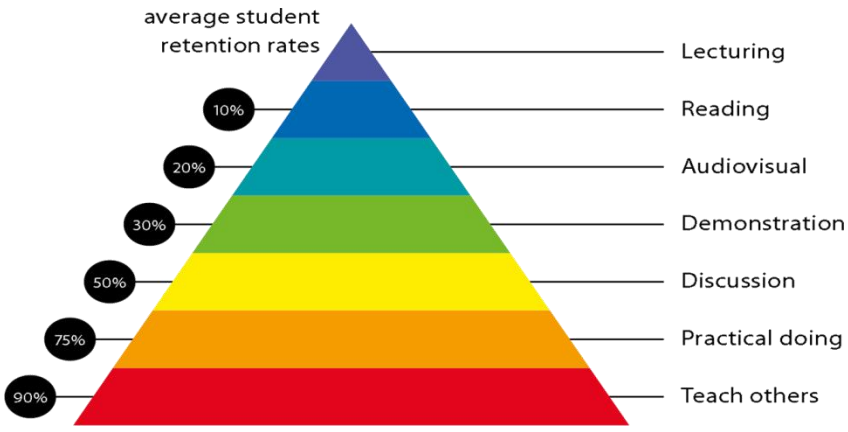


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication**
	6 Oral communication
	7 Teamwork

Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

Lecture/tutorial times

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

Details of referencing system to be used in written work

Text books

1. Handbook of biomedical instrumentation, R. S. Khandpur, Tata McGraw Hill, New Delhi.
2. Introduction to biomedical equipment technology, Carr Joseph J.,Brown J.M, Pearson education, New Delhi
3. Biomedical instrumentation measurements, Lesli P Cromwell, Fred J. Weibell, Erich A. Pfeiffer, PHI Learning, New Delhi

4. Medical instrumentation application & design, John G. Webster, Editor, John Wiley and Sons, New Delhi

Additional Materials

SSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

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Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

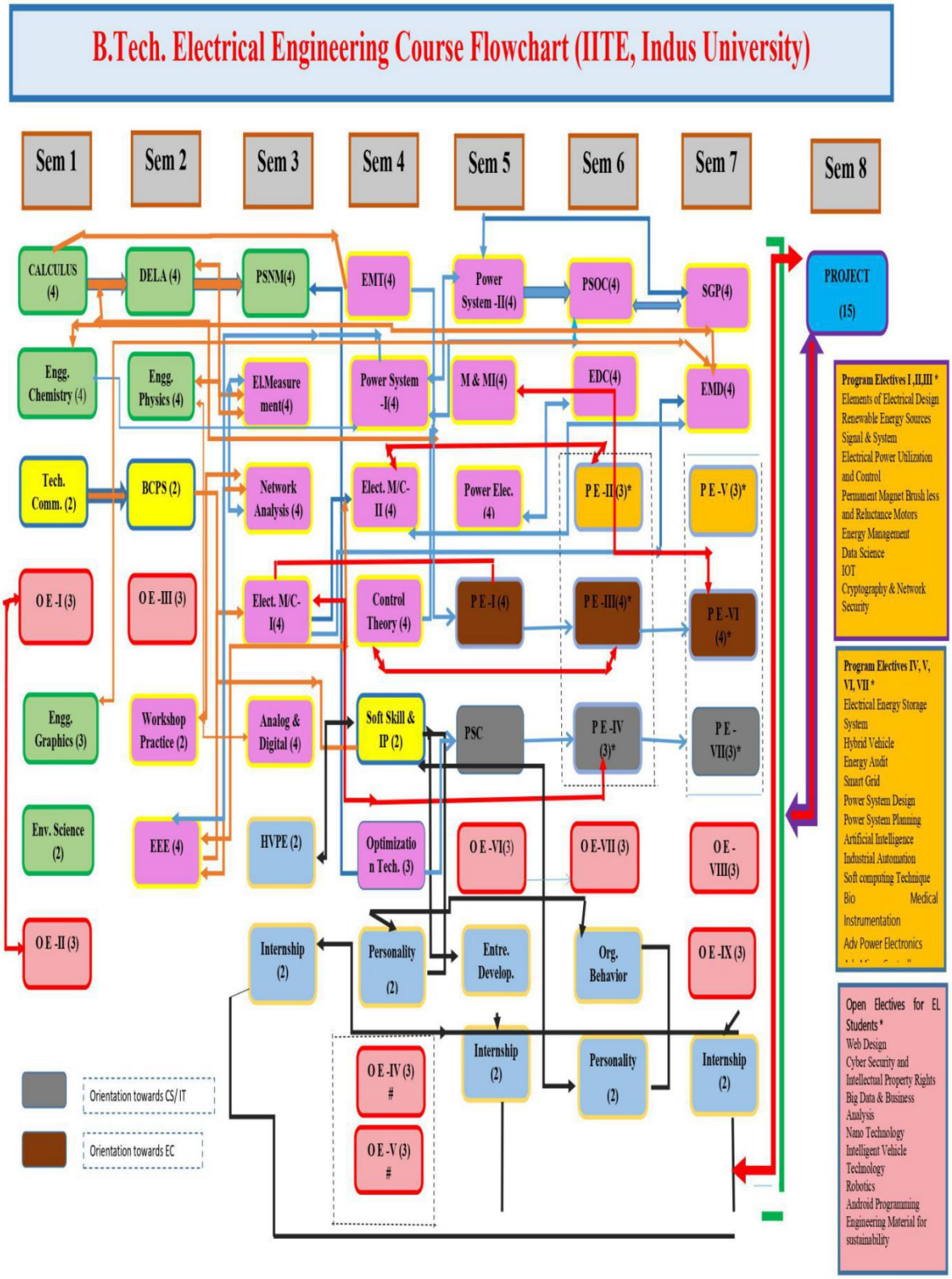
.

Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Fundamentals of medical instrumentation. Sources of biomedical signals, Generalized medical instrumentation block diagram	2	BB
	Week 2	Medical electrodes - ECG,EEG,EMG, Defibrillator, Medical transducers	2	BB
	Weeks 3	Body temperature, Blood pressure, respiration rate, Classification of Medical instruments based on:	2	BB
	Week 4	Application - (diagnostic, therapeutic, Imaging, analytical) Physiological parameter and biopotential Biological system Different departments in the hospital.	1	BB
	Week 5	Application - (diagnostic, therapeutic, Imaging, analytical) Physiological parameter and biopotential Biological system Different departments in the hospital.	1	BB
	Week6	Electrocardiograph(ECG) machine, ECG block diagram, Bipolar and unipolar leads	*1*	BB
	Week7	ırdiograph, Electroencephalograph Electrode placement system, EEG device, Electro-myograph (EMG) Bio-feedback Instrumentation	1	BB

	Week 8	ardiograph, Electroencephalograph Electrode placement system, EEG device, Electro-myograph (EMG) Bio-feedback Instrumentation		BB
	Week 9	X-ray machine. CT-Scan machine. Properties of ultrasound Ultrasonic foetal monitors.	2	BB
	Week 10	ephalography. Echo-cardiograph. Colour ultrasound machine.		BB
	Week 11	ephalography. Echo-cardiograph. oppler ultrasound machine.		BB
	Week 12	Electro-surgery machine (cautery), Hemo-dialysis machine,		BB
	Week 13	imulators, Defibrilator Machine, Bio y analyzer. 5.4 Auto analyzer. 5.5 Blood zer.		BB
	Week 14	imulators, Defibrilator Machine, Bio y analyzer. 5.4 Auto analyzer. 5.5 Blood zer.		BB
	Week 15	Revision		BB


B.Tech. Electrical Engineering Course Flowchart (IITE, Indus University)
Sem 1
Sem 2
Sem 3
Sem 4
Sem 5
Sem 6
Sem 7
Sem 8
CALCULUS (4)
DELA (4)
PSNM(4)
EMT(4)
Power System -II(4)
PSOC(4)
SGP(4)
PROJECT (15)
Engg. Chemistry (4)
Engg. Physics (4)
EL.Measurement(4)
Power System -I(4)
M & MI(4)
EDC(4)
EMD(4)
Tech. Comm. (2)
BCPS (2)
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Elect. M/C-II (4)
Power Elec. (4)
P E -II(3)*
P E -V (3)*
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Analog & Digital (4)
Soft Skill & IP (2)
PSC
P E -IV (3)*
P E - VII(3)*
Env. Science (2)
EEE (4)
HVPE (2)
Optimization Tech. (3)
O E -VI(3)
O E-VII (3)
O E - VIII(3)
O E -II (3)
Internship (2)
Personality (2)
Entre. Develop.
Org. Behavior
O E -IX (3)
O E -IV (3) #
O E -V (3) #
Internship (2)
Personality (2)
Internship (2)
Orientation towards CS/ IT
Orientation towards EC
Program Electives I ,II,III *
Elements of Electrical Design
Renewable Energy Sources
Signal & System
Electrical Power Utilization and Control
Permanent Magnet Brush less and Reluctance Motors
Energy Management
Data Science
IOT
Cryptography & Network Security
Program Electives IV, V, VI, VII *
Electrical Energy Storage System
Hybrid Vehicle
Energy Audit
Smart Grid
Power System Design
Power System Planning
Artificial Intelligence
Industrial Automation
Soft computing Technique
Bio Medical Instrumentation
Adv Power Electronics
Open Electives for EL Students *
Web Design
Cyber Security and Intellectual Property Rights
Big Data & Business Analysis
Nano Technology
Intelligent Vehicle Technology
Robotics
Android Programming
Engineering Material for sustainability

Name of Institute: Indus Institute of Technology & Engineering
Name of Faculty:Vineeta S. Chauhan

Course code: EL0717
Course name: Electrical Machine Design

Pre-requisites:

i) Differential Equations
ii) Basics of Transformer
iii) Basics of DC Machine

Credit points: 04

Offered Semester: VII

Course coordinator (weeks 01 - 15)
Full name: Vineeta S. Chauhan
Department with siting location: 2nd floor, Bhawar Building
Telephone:3211
Email: vineetachauhani.el@indusuni.ac.in
Consultation times: 4:00 p.m. to 5:00 p.m.

Course lecturer (weeks 01 - 15)
Full name: Vineeta S. Chauhan
Department with siting location: 2nd floor, Bhawar Building
Telephone:3211
Email: vineetachauhani.el@indusuni.ac.in
Consultation times: 4:00 p.m. to 5:00 p.m.

Students will be contacted throughout the session via mail with important information relating to this course.

Course Objectives

By participating in and understanding all facets of this course a student will:

(i) To understand different different insulating Materils.
(ii) To learn the concept of Transformer Design.
(iii) To learn the concept of DC machine Design.
(iv) To learn the concept of CT & PT.
(v) Compare out power torque parameters for different size machine.
(vi) Know the calculation of the instrument transformers.

Course Outcomes (CO)

CO-1: Describe the traditional methodologies for the analysis and the design of the electrical machines.[BT-1]

CO-2: Analyse the heat losses, core losses and mechanical losses of dc machine.[BT-4]

CO3: Design of induction motor and give the information required for the fabrication of the same along with an estimation of various performance index. [BT6]

CO4: Demonstrate knowledge to carry out a detailed design of wound rotor and give the information required for the fabrication of the same along with an estimation of various performance indexes.[BT3]

CO5: Analyze detailed design of synchronous machines and provide the information required for the fabrication of the same along with an estimate of various performance indexes. [BT4]

CO6: Design various parameters for various static and rotating machines. [BT6]

Course Outline

In this course students will learn about various Insulating Materials, Transformer, DC Machine & CT/PT Design.

Method of delivery

Face to face lectures, Assignments, Quiz

Study time

3-Hour lecture, 2 hrs tutorial per week

CO-PO Mapping (PO: Program Outcomes)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3	1	2	1	1	2	1	-	1	1	-	2
CO2	3	2	2	1	1	1	1	-	1	2	-	2
CO3	3	3	3	1	2	1	1	1	1	1	1	2
CO4	3	3	3	3	2	1	2	2	2	1	1	2
CO5	3	2	1	1	1	2	1	-	1	1	-	2
CO6	3	3	3	2	2	1	1	1	1	2	1	2

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

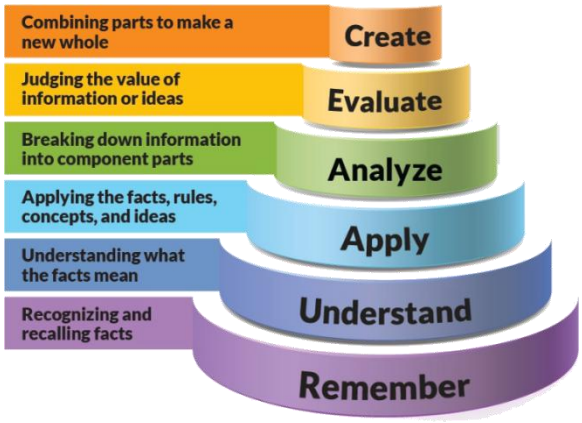

Figure 1: Blooms Taxonomy

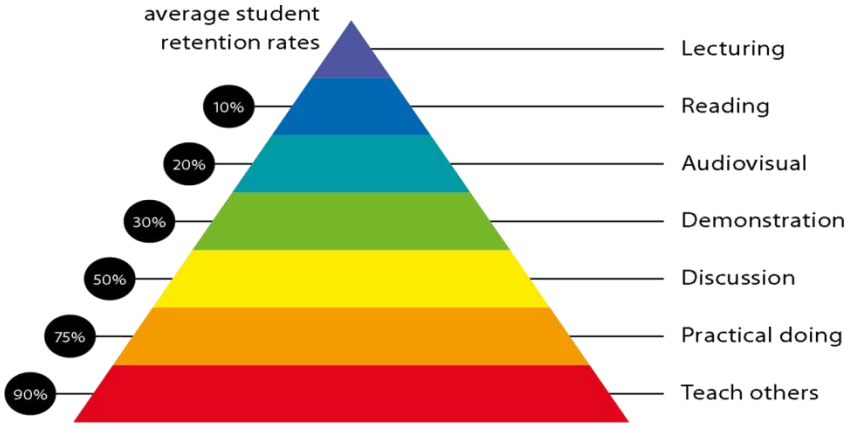

Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies.	**2 Information literacy, gathering & processing**

Acknowledge the work and ideas of others.	
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

Design Sheets , Designing based on MATLAB program

Lecture/tutorial times

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

Details of referencing system to be used in written work

Text books

1. Sawhney, A.K. "A Course in Electrical Machine Design", DhanpatRai and Sons, New Delhi.
2. Sen, S.K., "Principles of Electrical Machine Design with Computer Programmes," Oxford and IBH Publishing Co. Pvt Ltd., New Delhi, 1987.

Additional Materials

1. Upadhyay, K.G., "Design of Electrical Machine," New Age International Publishers, New Delhi.
2. V.N.Mittle & A.Mittal."Design of Electrical Machines"Standard Publishers Distributors, Delhi-32.

Web Resource

1. www.bookspar.com

MOOCS:

i) https://www.edx.org/
ii) https://www.nptel.ac.in/
iii) https://www.coursera.org/

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Theory

CIE 60 marks (40 marks mid semester examination + 20 marks internal evaluation)

Components of internal evaluation
05 marks as attendance bonus for all students having attendance > 80%
05 marks for presentation
10 marks for assignment or case studies

Laboratory

File Work (10 marks)
Lab Participation (20 marks)
Project / Presentation (20 marks)
Viva – Voice (10 marks)

End Term Examination: 40 marks

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves

available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

Design sheets , MATLAB based Machine Design

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

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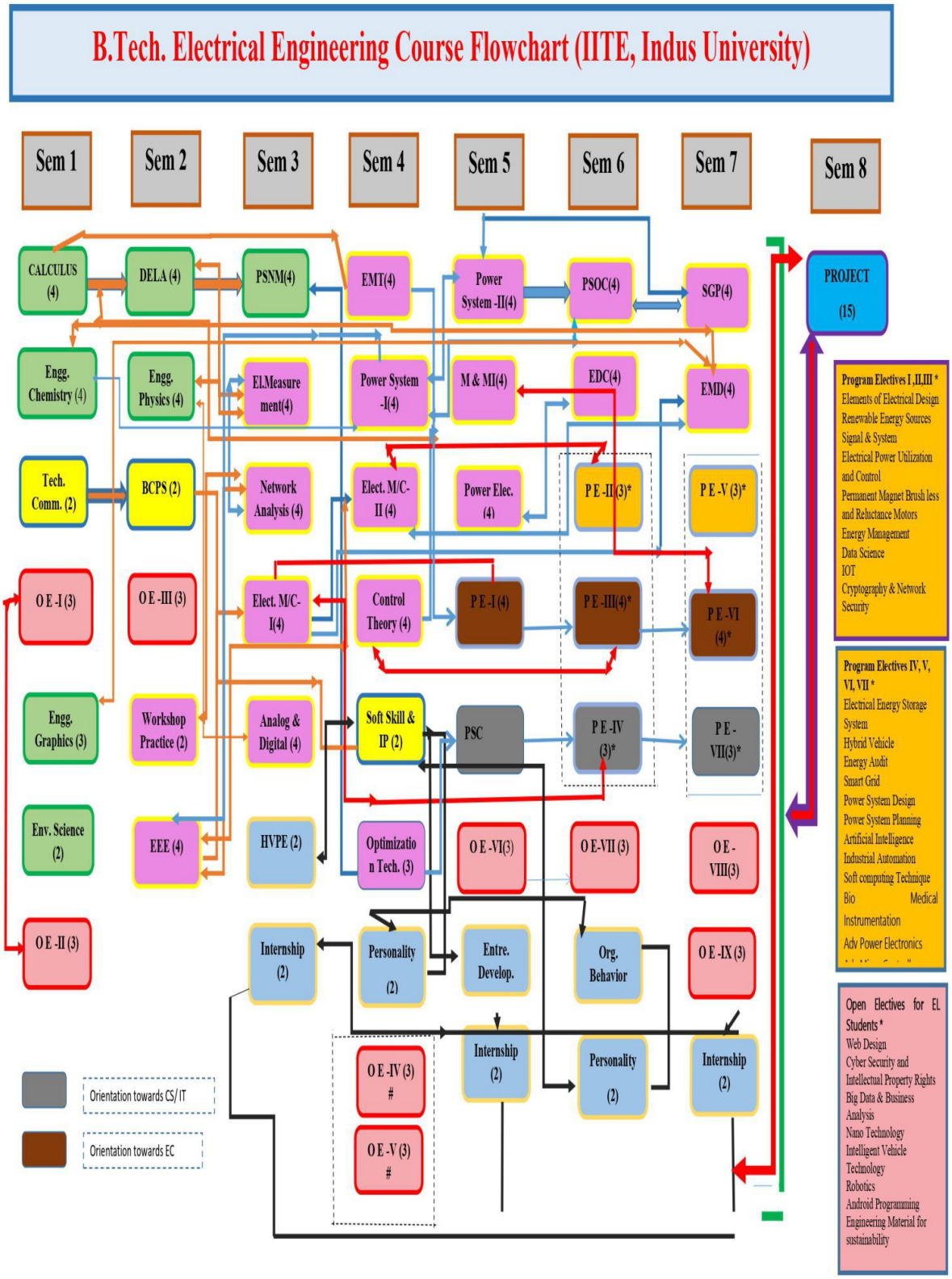
Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	**Design of DC Machines:**Output Equation, Choice of Specific Loadings and Choice of Number of Poles,	2	BB
	Week 2	Main Dimensions of armature, Design of Armature Slot Dimensions.		BB
	Weeks 3	Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap. Design of Shunt and Series Field Windings.	2	BB
	Week 4	Selection of B av & ac, Duty cycle and equivalent ratings. Types of transformers, position of HV and LV windings	1	BB
	Week 5	core and yoke cross sectional area, importance of mitered joints., Different types of transformers windings		BB
	Week6	Different methods for cooling of transformer, Different positions of tapings. Output equation for 3 phase transformers, window space factor, factors affecting window space factor.	*1*	BB
	Week7	Relation between emf per turn and transformer rating, factors affecting constant K, stacking factor, examples.	1	BB
	Week 8	Selection of flux density and current density, Window dimensions, Yoke dimensions and overall core dimension calculations		BB
	Week 9	examples. Design of HV and LV windings (No. of turns and area of cross section). Estimation of operating characteristics.	2	BB
	Week 10	Primary and secondary winding resistance. Leakage reactance calculation of only cylindrical coil with equal height, Leakage reactance of unequal windings and heights,		BB

	Week 11	**Design of Three Phase Induction Motors:** Output Equation, Choice of Specific Loadings, Main Dimensions of Stator	*2*	BB
	Week 12	Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring.	3,4	BB
	Week 13	Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance.	4	BB
	Week 14	**Design of Three Phase Synchronous Machines:** Output Equation, Choice of Specific Loadings, Short Circuit Ratio	*3*	BB
	Week 15	Main Dimensions of Stator. Design of stator slots and Winding.Design of Salient and non- salient Pole Rotors. Magnetic Circuit and Field Winding.	5	BB


B.Tech. Electrical Engineering Course Flowchart (IITE, Indus University)
Sem 1
Sem 2
Sem 3
Sem 4
Sem 5
Sem 6
Sem 7
Sem 8
CALCULUS (4)
DELA (4)
PSNM(4)
EMT(4)
Power System -II(4)
PSOC(4)
SGP(4)
PROJECT (15)
Engg. Chemistry (4)
Engg. Physics (4)
El.Measurement(4)
Power System -I(4)
M & MI(4)
EDC(4)
EMD(4)
Tech. Comm. (2)
BCPS (2)
Network Analysis (4)
Elect. M/C-II (4)
Power Elec. (4)
PE -II(3)*
PE -V (3)*
OE -I (3)
OE -III (3)
Elect. M/C-I(4)
Control Theory (4)
PE -I (4)
PE -III(4)*
PE -VI (4)*
Engg. Graphics (3)
Workshop Practice (2)
Analog & Digital (4)
Soft Skill & IP (2)
PSC
PE -IV (3)*
PE - VII(3)*
Env. Science (2)
EEE (4)
HVPE (2)
Optimization Tech. (3)
OE -VI(3)
OE-VII (3)
OE - VIII(3)
OE -II (3)
Internship (2)
Personality (2)
Entre. Develop.
Org. Behavior
OE -IX (3)
Internship (2)
OE -IV (3) #
OE -V (3) #
Personality (2)
Internship (2)
Orientation towards CS/ IT
Orientation towards EC
Program Electives I ,II,III *
Elements of Electrical Design
Renewable Energy Sources
Signal & System
Electrical Power Utilization and Control
Permanent Magnet Brush less and Reluctance Motors
Energy Management
Data Science
IOT
Cryptography & Network Security
Program Electives IV, V, VI, VII *
Electrical Energy Storage System
Hybrid Vehicle
Energy Audit
Smart Grid
Power System Design
Power System Planning
Artificial Intelligence
Industrial Automation
Soft computing Technique
Bio Medical Instrumentation
Adv Power Electronics
Open Electives for EL Students *
Web Design
Cyber Security and Intellectual Property Rights
Big Data & Business Analysis
Nano Technology
Intelligent Vehicle Technology
Robotics
Android Programming
Engineering Material for sustainability

Class Test:

Q.1 A design is required for a 50kW,4pole,600rpm, and 220V dc shunt generator. The average flux density in the air gap and specific electric loading are respectively 0.57T and 30000 ampere-conductors per metre. Calculate suitable dimensions of armature core to lead to a square pole face. Assume that full load armature drop is 3% of the rated voltage and the field current is 1% of rated full load current. Ratio pole arc to pole pitch is 0.67.

Q.2 For a preliminary design of a 50hp, 230V, 1400 rpm dc motor, calculate the armature diameter and core length, number of poles and peripheral speed. Assume specific magnetic loading 0.5T, specific electric loading 25000 ampere- conductors per meter, efficiency 0.9.

Q.3 Determine the diameter and length of the armature core for a 55kW, 110V, 1000rpm, and 4pole dc shunt generator. Assume:
Specific magnetic loading 0.5T, Specific electric loading 13000 ampere –turns,
Pole arc 70% of pole pitch and length of core about 1.1 times the pole arc, Allow 10A for field current and a voltage drop of 4V for the armature circuit.
Determine also the number of armature conductors and slots.

Q.4 Determine the main dimensions of the armature core, number of conductors, and commutator segments for a 350kW, 500V, 450 rpm, 6pole shunt generator assuming a square pole face with pole arc 70% of the pole pitch. Assume the mean flux density to be 0.7T and ampere- conductors per cm to be 280.

Q.5 Determine the number of poles, armature diameter and core length for the preliminary design of a 500kW, 400V, 600 rpm, dc shunt generator assuming an average flux density in the air gap of 0.7 T and specific electric loading of 38400 ampere- conductors per metre. Assume core length/ pole arc = 1.1. Apply suitable checks.

Q.6 Draw the following views of a 3 phase, core type, 250 kVA, 11 kV / 400 V transformer-i) Front elevation in full section and ii) Plan in full section
Cross section of the core: 3 Stepped
Diameter of the circum circle = 24 cm
Centre to centre distance between adjacent limbs = 42.5 cm
Yoke height = 25 cm
Total height of transformer = 100 cm

Q.7 Draw Sectional Elevation, Sectional Plan and End-view of a 5 kVA, core type, single phase transformer for the data given -
Circumscribing Circle = 80 mm diameter
Width of Core = 55 mm, Height of Yoke = 65 mm
LV –Internal diameter = 83mm
LV –External diameter = 98mm
HV –Internal diameter = 114mm
HV –External diameter = 135mm
Over all width of the magnetic frame = 215mm
Over all height of the magnetic frame = 350mm
Center to center distance between limbs =160mm

Q.8 Why the area of yoke of a transformer is usually kept 15 to 20 % more than that of core?

Q.9 What is the cause of noise in transformer?

Q.10 What are the important properties of transformer steel?

Q.11 Why stepped core are generally used for transformer?

Quiz:

1 Which of the following is the major consideration to evolve a good design ?

(a) Cost
(b) Durability
(c) Compliance with performance criteria as laid down in specifications
(d) All of the above

2 Impose limitation on design.
(a) Saturation
(b) Temperature rise
(c) Efficiency
(d) Power factor
(e) All above

3 The efficiency of a machine should be as _____ as possible to reduce the operating cost.
(a) high
(b) low
(c) either of the above
(d) none of the above

4 If an insulating material is operated beyond the maximum allowable temperature, its life is
(a) drastically increased
(b) drastically reduced
(c) unaffected
(d) none of the above

5 The design of mechanical parts is particularly important in case of _____ speed machines.
(a) low
(b) medium
(c) high
(d) any of the above

6 In induction motors, the length of air gap in kept as small as mechanically possible is order to have
(a) low power factor
(b) high power factor
(c) high over load capacity
(d) any of the above

7 In _____ machines, the size of the shaft is decided by the critical speed which depends
on the deflection of the shaft.
(a) small
(b) medium
(c) large
(d) any of the above.

8 The length cf air gap to be provided in _____ is primarily determined by power factor consideration.
(a) d.c. series motor .
(b) d.c. shunt motor
(c) induction motor
(d) synchronous motor

9 Electrical machines having a power output upto about 750 W may be called_____machines.
(a) small size
(b) medium size
(c) large size
(d) any of the above

10 Electrical machines having power outputs ranging from a few kW upto approximately 250 kW may be classified as
(a) small size machines
(b) medium size machines
(c) large size machines
(d) any ofthe above

ASSIGNMENT:01
SUB: ELECTRICAL MACHINE DESIGN-I

Que:1 Make a brief comparison chart between copper and aluminum when used in electrical machine winding.
Que:2 List out different properties of insulating materials.
Que:3 What are the different causes of failure of insulation?
Que:4 Explain different modes of heat dissipation?
Que:5 Difference between Distribution & Power Transformer.
Que:6 Difference between shell type and core type transformer.
Que:7 Define following terms:
(i) Window space factor
(ii) Specific magnetic loading
(iii) Specific Electric Loading
(iv) stacking factor
(v) field form factor
Que:8 Derive the output equation of a D.C. machine
Que:9 Estimate the main core dimension for a 50Hz, 3-phase 200kVA, 6600/500 volts star/mesh core type transformer. Use the following data:
Core limb section to be 4-stepped for which the area factor =0.62, Window space factor=0.27, Height of window which is two times width of window, current density =2.8MA/m2, Volts per turn=8.5, maximum flux density=1.25wb/m^2, Take Ai=0.62d^2
Que:10 Determine the main dimensions of the core and window for a 500 kVA, 6600/400V, 50Hz, Single phase core type, oil immersed, self-cooled transformer. Assume: Flux density = 1.2 T, Current density = 2.75 A/mm2, Window space factor = 0.32, Volt / turn = 16.8, type of core: Cruciform, height of the window = 3 times window width. Also calculate the number of turns and cross-sectional area of the conductors used for the primary and secondary windings.
Que:11 Find the width of window for optimum output of a transformer.
Que:12 Why stepped cores are used in transformers?
Que:13 What are the major considerations to evolve a good design of electrical machine?
Que:14 How will the output and losses in a transformer vary with linear dimension?
Que:15 Develop the output equation for a three phase transformer.

SYLLABUS

Subject: Electrical Machine Design								
Program: B.Tech.				**Subject Code: EL0717**			**Semester: VII**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	60	40	60	40	200

Unit 1 **[09]**

Design of DC Machines: Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap. Design of Shunt and Series Field Windings.

Unit 2 **[10]**

Design of Transformers: Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, No Load Current. Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation. Design of Tank and Cooling (Round and Rectangular) Tubes.

Unit 3 **[10]**

Design of Three Phase Induction Motors: Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance.

Unit 4 **[16]**

Design of Three Phase Synchronous Machines: Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non- salient Pole Rotors. Magnetic Circuit and Field Winding.

Test Book

1. A COURCE IN Electrical Machine Design, A K Sawney, Dhanpat Rai and Sons.

Reference Book

2. Electrical machine Design- R K Agarwal, S K kataria & Sons.

Name of Institute: Indus Institute of Technology & Engineering
Name of Faculty: Hinal Shah

Course code: EL0722
Course name: Industrial Automation
Pre-requisites:
Basics of Electrical Engineering
Analog Circuit
Control System

Credit points: 04
Offered Semester: VII

Course Coordinator
Full Name: Hinal Shah
Department with siting location: Electrical Engineering Department, 3rd floor Bhawar Building.Staff room
Telephone: 9727554848
Email: hinalshah.el@ indusuni.ac.in
Consultation times: 9:00AM to 4:30PM

Course Lecturer
Full Name: Hinal Shah
Department with siting location: Electrical Engineering Department, 3rd floor Bhawar Building.Staff room
Telephone: 9727554848
Email: hinalshah.el@ indusuni.ac.in
Consultation times: 9:00AM to 4:30PM

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Objectives

By participating in and understanding all facets of this Course a student will:

1) Be able to develop understanding for different types of processes in industry
2) Be able to understand requirement of automation and control
3) Understand applications of various types of controllers
4) Be able to provide the understanding of PLC, SCADA and DCS systems.

5) Understand the sensing, programming and actuation part of control system

Course Outcomes (CO)
CO 1: Explain types of Production and automation system.[BT-2]

CO 2: Discuss discontinuous and continuous controller for automation applications.[BT-2]

CO 3: Select Continuous, discontinuous and composite controller for industrial applications.[BT-4]

CO 4: Describe PLC Architecture and Input-output module. .[BT-2]

CO 5: Apply Ladder programming of PLC in Automation application.[BT-3]

CO 6: Describe DCS and SCADA system with its application..[BT-2]

Course Outline

This course mainly deals with different types of process automation system. It covers how the reactive behavior achieved with different types of controllers in different type of automation systems and how large-scale systems like SCADA and DCS work. Complete understanding automation and control system from sensing to actuation and programming for decision making in process control is covered in this course.

Unit-1 [10]

General Concepts:

General concepts of the industrial production. Concepts of production systems and production processes, Automation production systems and their classification.

Process Control Loop and its Characteristic:

Controlled variable, controlling parameters, process equation load, transient, process, lag, self-regulation, control lag, variable range, dead time, cycling, Realizing control using analog electronics

Unit-2 **[11]**

Control Algorithms: Characteristic of different discontinuous controller mode, two position mode, multi position mode, floating control mode, introduction of different continuous controller mode, proportional, integral, derivative, PI, PID controller mode.

Unit-3 **[12]**

Architecture by block diagram, I/O modules, Memory and storage, Scan Cycle, programming language- ladder diagram, FBD approach, Introduction to analog signal processing, interlocking, permissive, realization of Logic gates, Automation application.

Unit-4 **[12]**

Programmable Logic Controller (PLC):

Timer and counter operation of PLC and it's application.

Distributed Control System:

Evaluation of DCS, system architecture-hierarchical of DCS at function levels, Database organization, system implementation concepts System elements- fields, station, intermediate station, central computer system, Monitoring and communication facilities, data communication link transfer of process data, SCADA.

Method of delivery

Face to face lectures

Study time

3 Hour Lecture and 2 Hour Laboratory per week

CO-PO Mapping (PO: Program Outcomes)

Mapping CO's with PO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	1	-	1	-	-	-	-	-	-	-	-
CO2	2	3	2	2	-	-	-	-	-	-	-	-
CO3	2	3	3	2	-	-	-	-	-	-	-	-
CO4	3	2	1	1	2	-	-	-	-	-	-	-
CO5	2	3	3	2	-	-	-	-	2	-	-	-
CO6	3	2	2	2	2	-	-	-	2	-	-	

1-Lightly Mapped 2- Moderately Mapped 3- Highly Mapped

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

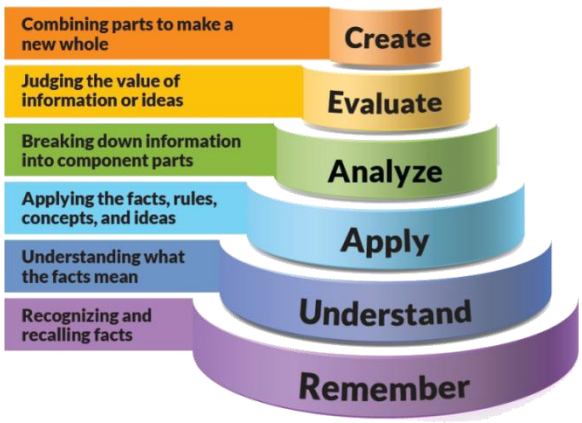


Figure 1: Blooms Taxonomy

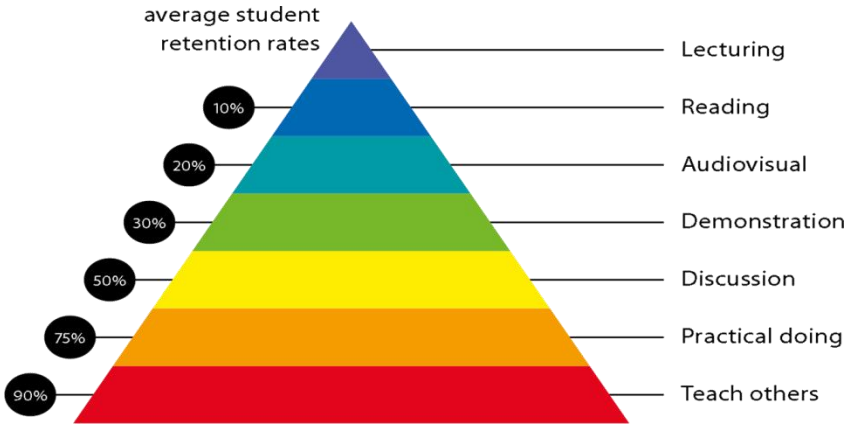


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of Electrical Engineering Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

1. To develop a Ladder Logic program for Logical Gates.
2. To develop a ladder diagram for a sequential lamp ON/OFF.
3. To understand and verify interlocking and permissive operation of PLC
4. To develop drilling machine application.
5. To develop a ladder diagram for a bottle filing and conveyor belt.
6. To develop a Ladder Logic program for stepper motor.
7. To develop a Ladder Logic diagram of Traffic Light Control.
8. To develop two axis robotic arm application using PLC.
9. To Study of SCADA & DCS based industrial automation.

Lecture/tutorial times

Lecture
Tuesday – 9:00 to 10:00am
Wednesday - 12:20-1:20pm
Thursday – 11:10am to 12:10am

Laboratory
Friday 11:10am to 1:20pm

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.Details of referencing system to be used in written work

Text books

1. Johnson, C. D., “Process Control Instrumentation Technology”, Prentice Hall.
2. Liptak, B. G., “Instrument Engineers – Handbook”, (Vol. – II), CRC Press.
3. Morriss, S. B., “Programmable Logic Controllers”, Prentice hall.

Additional Materials

1. Webb, J. W., and Reis, R. A., “Programmable Logic Controllers: Principles & Applications”, Prentice Hall, (2002).
2. Shinskey, F. G., “Process Control Systems: Application, Design and Tuning”, McGraw-Hill

Professional, (1996).

3. Thomas E. Marlin, "Process Control: Designing Processes and Control for Dynamic Performance", McGraw – Hill, International Edition
4. Dale E. Seborg, Thomas F. Edger, Duncan A. Mellichamp, "Process Dynamics and Control", Wiley India.
5. Surekha Bhanot, "Process Control: Principles and Applications", Oxford University Press.
6. Peter Harriot, "Process Control", Tata - McGraw Hill. Patranabis, "Principles of Process Control", Tata - McGraw Hill.

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Mid semester (40 marks)		
Assignment (10 marks)		
Innovative/Project/Presentation/Attendance (10 marks)		
Final exam (*closed book*)	**(40 marks)**	**Objectives (1-6)**

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

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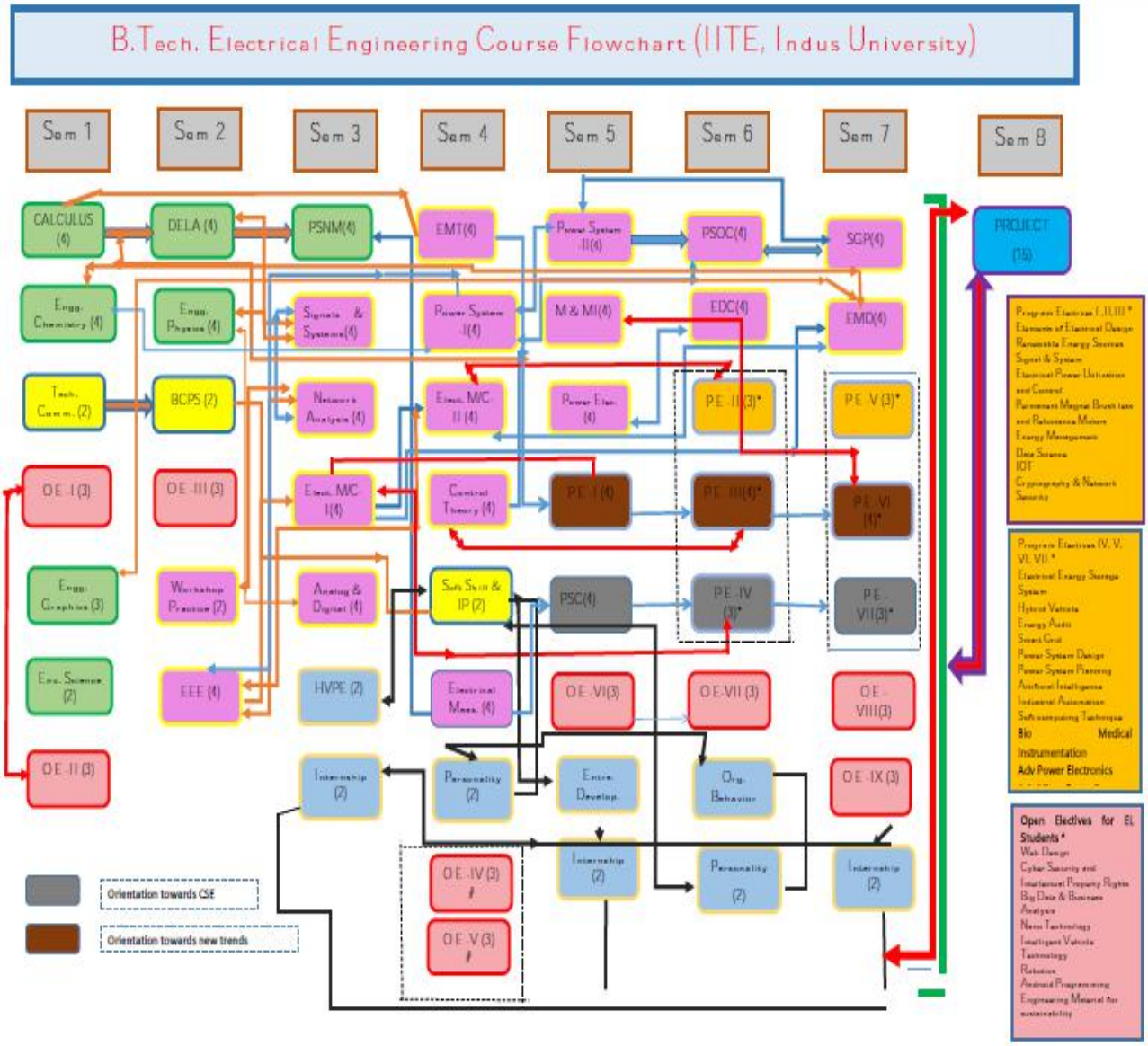
Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	General concepts of the industrial production. Concepts of production systems and production processes. Automation production systems and their classification.	CO1, CO2	Chak & Talk
	Weeks 2	Process Control Loop and its Characteristic: Controlled variable definition Examples Controlling parameters and Definition	CO1, CO2	Chak & Talk
	Week 3	Process equation load Transient, process lag self-regulation, control lag,	CO2	Chak & Talk
	Week 4	Variable range, dead time, cycling	CO1, CO2	Chak & Talk
	Week 5	Control Algorithms: Characteristic of different discontinuous controller mode, Two position mode Multi position mode Floating control mode	CO3, CO4	Chak & Talk
	Week 6	Introduction of different continuous controller mode, Proportional mode	CO3, CO4	Chak & Talk
	Week 7	Integral controller mode Derivative controller Mode	CO3, CO4	Chak & Talk
	Week 8	PI, PD, PID controller mode	CO3,CO4,CO5	Chak & Talk
	Week 9	Example and Application of controller mode	CO3, CO4	Chak & Talk
	Week 10	Programmable Logic Controller (PLC): Architecture by block diagram PLC Scan time Input cards and sensors of PLC Output cards & drivers of PLC	C05	Chak & Talk

	Week 11	Programming language- ladder diagram Interlocking, permissive Basics programming of PLC PLC Arithmetic operation	CO5, CO6	Chak & Talk
	Week 12	PLC compare function Types of Timers in PLC Timer programming of PLC Counters of PLC Counter programming of PLC Application Programming of PLC – Drilling M/C	C05, CO6	Chak & Talk
	Week 13	Distributed Control System: Evaluation of DCS System architecture-hierarchical of DCS at function levels Database organization System implementation concepts System elements- fields station	CO5, CO6	Chak & Talk
	Week 14	Intermediate station, central computer system Monitoring and communication facilities Data communication link transfer of process data	CO4, CO6	Chak & Talk
	Week 15	SCADA. Elements of SCADA System Application of SCADA	CO4,CO6	Chak & Talk


B.Tech. Electrical Engineering Course Flowchart (IITE, Indus University)
Sem 1
Sem 2
Sem 3
Sem 4
Sem 5
Sem 6
Sem 7
Sem 8
CALCULUS (4)
DELA (4)
PSNM(4)
EMT(4)
Power System -II(4)
PSOC(4)
SGP(4)
PROJECT (15)
Engg. Chemistry (4)
Engg. Physics (4)
Signals & Systems(4)
Power System -I(4)
M & MI(4)
EDC(4)
EMD(4)
Tech. Comm. (2)
BCPS (2)
Network Analysis (4)
Elect. M/C II (4)
Power Elec. (4)
PE -II(3)*
PE -V (3)*
OE -I (3)
OE -III (3)
Elect. M/C I(4)
Control Theory (4)
PE -I (4)
PE -III(4)*
PE -VI (4)*
Engg. Graphics (3)
Workshop Practice (2)
Analog & Digital (4)
Soft Skill & IP (2)
PSC(4)
PE -IV (3)*
PE -VII(3)*
Env. Science (2)
EEE (4)
HVPE (2)
Electrical Mass. (4)
OE-VI(3)
OE-VII (3)
OE -VIII(3)
OE -II (3)
Internship (2)
Personality (2)
Entre. Develop.
Org. Behavior
OE -IX (3)
OE -IV (3) #
OE -V (3) #
Internship (2)
Personality (2)
Internship (2)
Orientation towards CSE
Orientation towards new trends
Program Electives I, II, III *
Elements of Electrical Design
Renewable Energy Sources
Signal & System
Electrical Power Utilization and Control
Permanent Magnet Brushless and Reluctance Motors
Energy Management
Data Science
IOT
Cryptography & Network Security
Program Electives IV, V, VI, VII *
Electrical Energy Storage System
Hybrid Vehicle
Energy Audit
Smart Grid
Power System Design
Power System Planning
Artificial Intelligence
Industrial Automation
Soft computing Technique
Bio Medical Instrumentation
Adv Power Electronics
Open Electives for EL Students *
Web Design
Cyber Security and Intellectual Property Rights
Big Data & Business Analysis
Nano Technology
Intelligent Vehicle Technology
Robotics
Android Programming
Engineering Material for sustainability

Syllabus

Subject: Industrial Automation								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0722**			**Semester: VII**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	40	40	60	60	200

Perquisites:

1. Digital Logic Design
2. Control Theory
3. Analog Electronics

Course Objectives:

1. To understand the process control and its characteristics in Automation
2. To understand operation of different controller mode and its application
3. To know Basic PLC and its programming.
4. To learn PLC, DCS and SCADA interface and its application.

Course Outcome:

After successful completion of the course, student will able to:

1. Students have good knowledge of types of automation.
2. Students know concept process control and importance of automation.
3. The student can understand the application of different controller.
4. Analyze the limitation and advantages of different control mode
5. Apply the Ladder programming of PLC in Automation application.
6. Apply the knowledge of DCS and SCADA application.

SYLLABUS

UNIT-I **[10]**

General Concepts:

General concepts of the industrial production. Concepts of production systems and production processes, Automation production systems and their classification.

Process Control Loop and its Characteristic:

Controlled variable, controlling parameters, process equation load, transient, process, lag, self-regulation, control lag, variable range, dead time, cycling, Realizing control using analog electronics

UNIT-II **[10]**

Control Algorithms:

Characteristic of different discontinuous controller mode, two position mode, multi position mode, floating control mode, introduction of different continuous controller mode, proportional, integral, derivative, PI, PID controller mode.

UNIT-III **[12]**

Programmable Logic Controller (PLC):

Architecture by block diagram, I/O modules, Memory and storage, Scan Cycle, programming language- ladder diagram, FBD approach, Introduction to analog signal processing, interlocking, permissive, realization of Logic gates, Automation application.

UNIT-IV **[12]**

Programmable Logic Controller (PLC):

Timer and counter operation of PLC and it's application.

Distributed Control System:

Evaluation of DCS, system architecture-hierarchical of DCS at function levels, Database organization, system implementation concepts System elements- fields, station, intermediate station, central computer system, Monitoring and communication facilities, data communication link transfer of process data, SCADA.

Text Books

1. Johnson, C. D., "Process Control Instrumentation Technology", Prentice Hall.
2. Webb, J. W., and Reis, R. A., "Programmable Logic Controllers: Principles & Applications", Prentice Hall, (2002).
3. Liptak, B. G., "Instrument Engineers – Handbook", (Vol. – II), CRC Press.
4. Morriss, S. B., "Programmable Logic Controllers", Prentice hall.

Reference Books

1. Shinskey, F. G., "Process Control Systems: Application, Design and Tuning", McGraw-Hill Professional, (1996).
2. Thomas E. Marlin, "Process Control: Designing Processes and Control for Dynamic Performance", McGraw – Hill, International Edition

3. Dale E. Seborg, Thomas F. Edger, Duncan A. Mellichamp, “Process Dynamics and Control”, Wiley India.
4. Surekha Bhanot, “Process Control: Principles and Applications”, Oxford University Press.
5. Peter Harriot, “Process Control”, Tata - McGraw Hill. Patranabis, “Principles of Process Control”, Tata - McGraw Hill.

Web resources

1. http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Industrial%20Automation%20control/pdf/L-01(SM)(IA&C)%20((EE)NPTEL).pdf
2. http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Industrial%20Automation%20control/pdf/L-39(SM)%20(IA&C)%20((EE)NPTEL).pdf
3. http://gpdlpune.ac.in/mainEN/IAM/DCS.pdf
4. http://www.nptel.ac.in/courses/108106022/12
5. http://www.nptel.ac.in/courses/108106022/8

MOOCs

1. https://www.edx.org/
2. https://www.nptel.ac.in/
3. https://www.coursera.org/

Name of Institute: Indus Institute of Technology & Engineering
Name of Faculty: Hinal Shah

Course code: EL0727
Course name:Progammable Logic Control(OE-8)
Pre-requisites:
Basics of Electrical Engineering
Analog Circuit
Control System

Credit points: 03
Offered Semester: VII

Course Coordinator
Full Name: Hinal Shah
Department with siting location: Electrical Engineering Department, 3rd floor Bhawar Building.Staff room
Telephone: 9727554848
Email: hinalshah.el@ indusuni.ac.in
Consultation times: 9:00AM to 4:30PM

Course Lecturer
Full Name: Hinal Shah
Department with siting location: Electrical Engineering Department, 3rd floor Bhawar Building.Staff room
Telephone: 9727554848
Email: hinalshah.el@ indusuni.ac.in
Consultation times: 9:00AM to 4:30PM

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Objectives

By participating in and understanding all facets of this Course a student will:

6) Able to understand requirement of automation and control
7) Able to provide the understanding of PLC systems.
8) Understand various peripheral of PLC and it's programming.
9) Able to develop logic and code for various application of PLC.

Course Outcomes (CO)

CO 1: Understand the fundamentals Programmable Logic Controllers systems.[BT-2]

CO 2: Identify the types of PLC communications and network systems. [BT-4]

CO 3: Design, edit, test, and document PLC Ladder Logic Programs.[BT-6]

CO 4: Solve & Write PLC programs.[BT-3]

CO 5: Apply Ladder programming of PLC in Automation application.[BT-3]

CO 6: Apply safety consideration for personnel, field devices and automated equipment.[BT-3]

Course Outline

UNIT-I **[10]**

INTRODUCTION

Principles of operation of PLC, PLC verses computer, PLC hardware components, Scan time of a cycle. Industrial PLC. Application of PLCs.

UNIT-II **[12]**

Memory and Logical Sensor

Memory Address, Program Files, Data files: User Bits Memory, Timer Counter Memory, PLC Status Bits, User Function Control Memory, Integer Memory, Floating Point Memory. Sensor wiring: Switches, TTL, Sinking and sourcing, Connection of switch. Human/ product Presence Detection Sensors: Reed Switch, Optical Sensor, Capacitive Sensor, Inductive Sensor

UNIT-III **[11]**

Boolean Logic Design and Timers, Counter , Latch Concept

Boolean algebra: Rules of Boolean Algebra, Logic Design for a given application. Common Logic Forms: Complex gate forms, Multiplexer. Timers: On-delay timer, Offdelay timer, Retentive timer. Counters: Up-Counters, DownCounter, Up-Down Counter. Master Control Relay.

UNIT-IV **[12]**

Ladder Logic Function and Advance Function

Data handling Function: Move Function, Mathematical Function, Conversion Function. Logic Function: Comparison of Value, Boolean Function. List Function: Shift registers, Stacks, Sequencer. Program Control: Branching and looping

Method of delivery

Face to face lectures

Study time

3 Hour Lecture per week

CO-PO Mapping (PO: Program Outcomes)

Mapping CO's with PO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	1	-	-	-	-	-	-	-	-	-	-
CO2	2	3	3	2	-	-	-	-	-	-	-	-
CO3	2	3	3	2	-	-	-	-	-	-	-	-
CO4	1	2	3	1	2	-	-	-	-	-	-	-
CO5	2	3	3	2	2	-	-	-	-	-	-	-
CO6	2.2	2.5	3	1.4	2	-	-	-	-	-	-	-

1-Lightly Mapped 2- Moderately Mapped 3- Highly Mapped

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

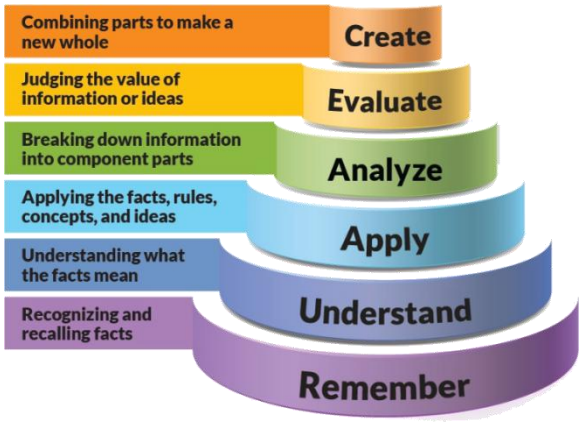


Figure 1: Blooms Taxonomy

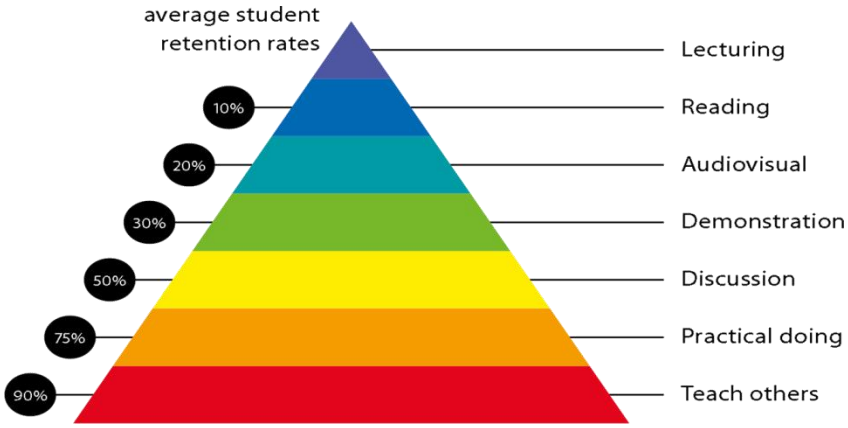


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of Electrical Engineering Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work: NA

Lecture/tutorial times

Lecture
Monday – 2:00 to 3:00pm
Wednesday - 9:00 to 10:00am
Thursday – 12:20pm to 1:20pm

Laboratory
-

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.Details of referencing system to be used in written work

Text books

4. Johnson, C. D., "Process Control Instrumentation Technology", Prentice Hall.
5. Liptak, B. G., "Instrument Engineers – Handbook", (Vol. – II), CRC Press.
6. Morriss, S. B., "Programmable Logic Controllers", Prentice hall.

Additional Materials

7. Webb, J. W., and Reis, R. A., "Programmable Logic Controllers: Principles & Applications", Prentice Hall, (2002).
8. Shinskey, F. G., "Process Control Systems: Application, Design and Tuning", McGraw-Hill Professional, (1996).
9. Thomas E. Marlin, "Process Control: Designing Processes and Control for Dynamic Performance", McGraw – Hill, International Edition
10. Dale E. Seborg, Thomas F. Edger, Duncan A. Mellichamp, "Process Dynamics and Control", Wiley India.
11. Surekha Bhanot, "Process Control: Principles and Applications", Oxford University Press.
12. Peter Harriot, "Process Control", Tata - McGraw Hill. Patranabis, "Principles of Process Control", Tata - McGraw Hill.

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Mid semester (20 marks)		
Assignment (10 marks)		
Innovative/Project/Presentation/Attendance (10 marks)		
Final exam (*closed book*)	**(40 marks)**	**Objectives (1-6)**

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.

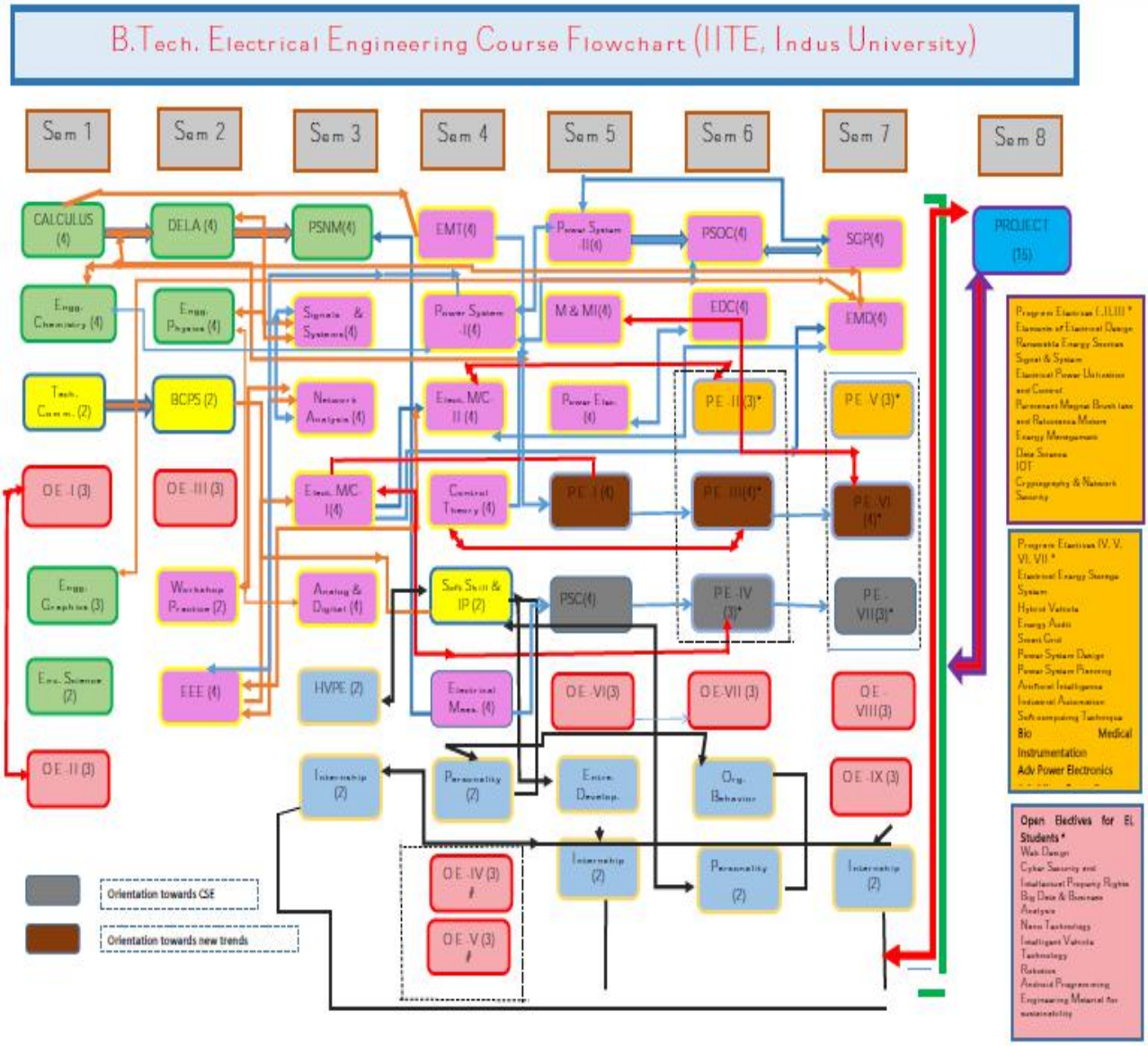
Do not share your work with other students (except where required for a group activity or assessment)

Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Principles of operation of PLC, PLC verses computer, PLC hardware components,	CO1	Chak & Talk
	Weeks 2	Scan time of a cycle. Industrial PLC. Application of PLCs.	CO1	Chak & Talk
	Week 3	Memory Address, Program Files, Data files: User Bits Memory, Timer Counter Memory.	CO1,CO2	Chak & Talk
	Week 4	PLC Status Bits, User Function Control Memory, Integer Memory, Floating Point Memory. Sensor wiring:	CO1, CO2	Chak & Talk
	Week 5	Switches, TTL, Sinking and sourcing, Connection of switch. Human/ product Presence Detection Sensors: Reed Switch, Optical Sensor, Capacitive Sensor, Inductive Sensor	CO2, CO6	Chak & Talk
	Week 6	Boolean algebra: Rules of Boolean Algebra, Logic Design for a given application. Common Logic forms	CO3, CO4	Chak & Talk
	Week 7	Complex gate forms, Multiplexer. Timers: On-delay timer, Offdelay timer, Retentive timer.	CO4,CO5,CO6	Chak & Talk
	Week 8	Counters: Up-Counters, DownCounter, Up-Down Counter. Master Control Relay.	CO4,CO5,CO6	Chak & Talk
	Week 9	PLC Programming Data handling Function: Move Function, Mathematical Function,	CO4,CO5,CO6	Chak & Talk
	Week 10	Conversion Function. Logic Function: Comparison of Value	CO4,CO5,CO6	Chak & Talk

	Week 11	PLC Application and Programming	CO4,CO5,CO6	Chak & Talk
	Week 12	Boolean Function. List Function:	C04,CO5	Chak & Talk
	Week 13	Shift registers, Stacks, Sequencer.	CO5, CO6	Chak & Talk
	Week 14	Program Control: Branching and looping	CO4, CO6	Chak & Talk
	Week 15	PLC Application and Programming	CO4,CO5,CO6	Chak & Talk


B.Tech. Electrical Engineering Course Flowchart (IITE, Indus University)
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M & MI(4)
EDC(4)
EMD(4)
Tech. Comm. (2)
BCPS (2)
Network Analysis (4)
Elect. M/C II (4)
Power Elec. (4)
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Entre. Develop.
Org. Behavior
OE -IX (3)
OE -IV (3) //
OE -V (3) //
Internship (2)
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Internship (2)
Orientation towards CSE
Orientation towards new trends
Program Electives I, II, III *
Elements of Electrical Design
Renewable Energy Sources
Signal & System
Electrical Power Utilization and Control
Permanent Magnet Brushless and Reluctance Motors
Energy Management
Data Science
IOT
Cryptography & Network Security
Program Electives IV, V, VI, VII *
Electrical Energy Storage System
Hybrid Vehicle
Energy Audit
Smart Grid
Power System Design
Power System Planning
Artificial Intelligence
Industrial Automation
Soft computing Technique
Bio Medical Instrumentation
Adv Power Electronics
Open Electives for EL Students *
Web Design
Cyber Security and Intellectual Property Rights
Big Data & Business Analysis
Nano Technology
Intelligent Vehicle Technology
Robotics
Android Programming
Engineering Material for sustainability

Syllabus

Subject: Progammable Logic Control								
Program: B.Tech. All Branches (Open Elective)				**Subject Code: EL0727**				**Semester: VII**
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	0	3	40	0	60	0	100

Course Objective

This course covers basic to intermediate theory & applications of programmable logic controllers. PLCs are used in many industrial and commercial processes. It is expected that some technicians will be required to install, troubleshoot, program & modify PLCs and PLC controlled systems. The intent of this course is to have students develop the basic technician level skills required by industry.

Course Outcome

1. Understand the fundamentals Programmable Logic Controllers systems.
2. Identify the types of PLC communications and network systems.
3. Design, edit, test, and document PLC Ladder Logic Programs.
4. Write PLC programs
5. Apply safety consideration for personnel, field devices and automated equipment.

UNIT-I **[10]**

INTRODUCTION

Principles of operation of PLC, PLC verses computer, PLC hardware components, Scan time of a cycle. Industrial PLC. Application of PLCs.

UNIT-II **[12]**

Memory and Logical Sensor

Memory Address, Program Files, Data files: User Bits Memory, Timer Counter Memory, PLC Status Bits, User Function Control Memory, Integer Memory, Floating Point Memory. Sensor wiring: Switches, TTL, Sinking and sourcing, Connection of switch. Human/ product Presence Detection Sensors: Reed Switch, Optical Sensor, Capacitive Sensor, Inductive Sensor

UNIT-III **[10]**

Boolean Logic Design and Timers, Counter , Latch Concept

Boolean algebra: Rules of Boolean Algebra, Logic Design for a given application. Common Logic Forms: Complex gate forms, Multiplexer. Timers: On-delay timer, Offdelay timer, Retentive timer. Counters: Up-Counters, DownCounter, Up-Down Counter. Master Control Relay.

UNIT-IV **[12]**

Ladder Logic Function and Advance Function

Data handling Function: Move Function, Mathematical Function, Conversion Function. Logic Function: Comparison of Value, Boolean Function. List Function: Shift registers, Stacks, Sequencer. Program Control: Branching and looping

Text Book

Petruzella, Frank D., (© 1998). Programmable Logic Controllers: 2/e, Glencoe/McGraw-Hill.

Name of Institute: IITE
Name of Faculty:

Course code: EL0719
Course name: Power System Design
Pre-requisites: Power system I, Power System II, Switch gear and Protection
Credit points: 4
Offered Semester: 7th

Course Coordinator
Full Name: Prof Jugal Lotiya
Department with siting location: Electrical, 4th floor staff room
Telephone: 97122698766
Email: jugallotiya.el@indusuni.ac.in
Consultation times: 3.45 to 4.20pm

Course Lecturer
Full Name: Prof Jugal Lotiya
Department with siting location: Electrical, 4th floor staff room
Telephone: 97122698766
Email: jugallotiya.el@indusuni.ac.in
Consultation times: 3.45 to 4.20pm

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Objectives

By participating in and understanding all facets of this Course a student will:

(vii) To understand different types of Transmission lines
(viii) To learn about different configuration of Line Conductors.
(ix) To understand the concept of EHV transmission line design.
(x) Analysis of different distribution system and its parameters.
(xi) To understand the Sizing and requirement of substation.
(xii) To understand different configuration of cables for Distribution System

Course Outcomes (CO)

1. Design 3 phase Transmission line and related parameters
2. Analysis of electrical and mechanical design parameters
3. Calculate the cable sizing , feeder sizing and Voltage regulation for Distribution system Design
4. Design EHV line based on bundle conductors and Design of EHV towers
5. To apply the design for HVDC system.
6. To apply the configuration for substation and different distribution system.

Course Outline

Proposed course mainly deal with Transmission line design, HVDC system Design, Distribution System and its configuration and substation design

Method of delivery

Face to face lectures

Study time

3 lectures + 2 Practical/week

CO-PO Mapping (PO: Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1	2	1	-	1	1	-	2
CO2	3	2	2	1	1	1	1	-	1	2	-	2
CO3	3	3	3	1	2	1	1	1	1	1	1	2
CO4	3	3	3	3	2	1	2	2	2	1	1	2
CO5	3	2	1	1	1	2	1	-	1	1	-	2
CO6	3	3	3	2	2	1	1	1	1	2	1	2

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

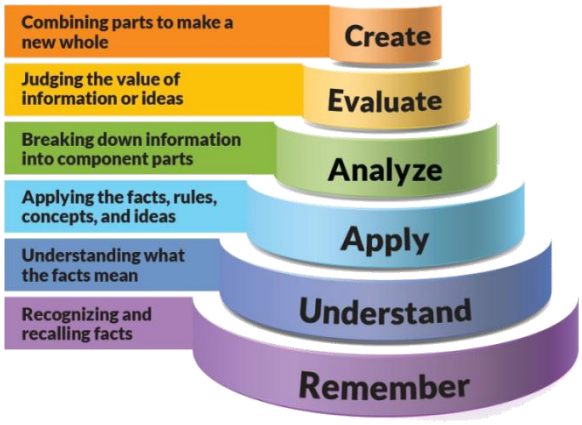

Figure 1: Blooms Taxonomy

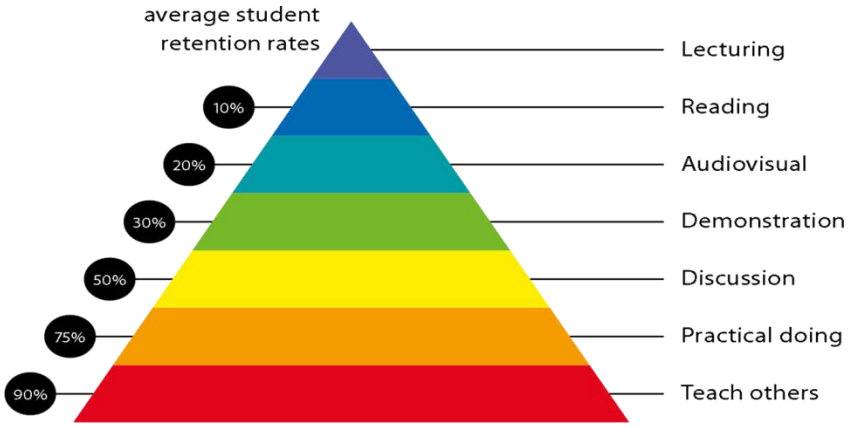

Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement	**4 Problem solving skills**

decisions. Be flexible, thorough, innovative and aim for high standards.	
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

1. To Design and Draw transmission line Insulators
2. To Design and Draw EHV transmission line Towers
3. To Design and Draw Earthing Grid.
4. To Design and Draw substation layout
5. Design Problem for HV and EHV transmission line.

Lecture/tutorial times

(Give lecture times in the format below)

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

Details of referencing system to be used in written work

Text books

1. Electrical Power System Design :M. V. Deshpande, TMH publication
2. Electrical Power System Design :B. R. Gupta, S. CHAND

Additional Materials

1. A course in Electrical Power: Soni,Gupta and Bhatnagar, Dhanpat Rai & Sons
2. Substation Design: Satnam & Gupta, DhanpatRai and Co.
3. Electrical Power System Planning A. S. Pabla, TMH publication

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Theory

CIE 60 marks (40 marks mid semester examination + 20 marks internal evaluation)

Components of internal evaluation
05 marks as attendance bonus for all students having attendance > 80%
05 marks for presentation
10 marks for assignment or case studies

Laboratory

File Work (10 marks)
Lab Participation (20 marks)
Project / Presentation (20 marks)
Viva – Voice (10 marks)

End Term Examination: 40 marks

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

-

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -1% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

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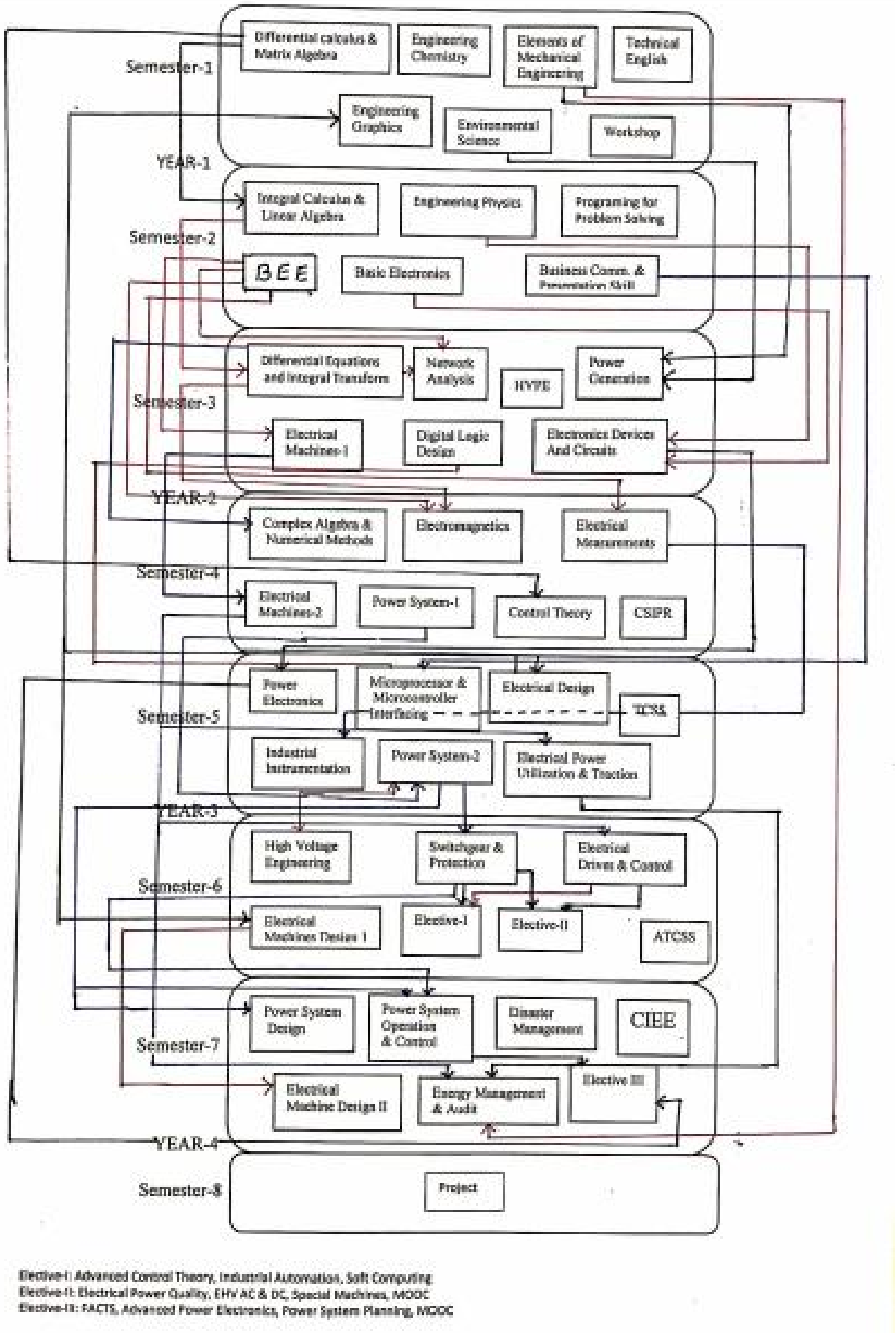
Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Introduction Electrical design of transmission line, Design philosophy, voltage level selection choice of conductors, spacing of conductor and corona insulators and SIL, design problem	1	BB, PPT
	Weeks 2	Mechanical design of transmission line Considerations, loading on conductors, span, sag and tension clearance, stringing Problems	1	BB, PPT
	Week 3	Transmission line tower design Location of tower, Earth wires, Reduction of tower footing resistance	2	BB, PPT
	Week 4	Location of tower, Earth wires, Reduction of tower footing resistance EHV Transmission Line Design Considerations, selection, spacing of conductors, corona and radio interference	2	BB, PPT
	Week 5	shunt and series compensation, tuned power lines, insulation coordination and different types of EHV towers, EHV systems in India.	3	BB, PPT
	Week 6	Introduction, Limitations of high voltage a.c. transmission Advantaged and limitations of HVDC transmission Principle of control of HVDC transmission	3	BB, PPT,

	Week 7	Applications of HVDC system Substation layout selection of sizes and locations of sub stations Substation equipments specifications ratings	3	BB, PPT
	Week 8	S/S operation from design view point selection of size and location of generating stations Interconnection	4	BB, PPT, MATLAB tool
	Week 9	Objectives, Definitions Tolerable limits of body currents, Soil resistivity Earth resistance, Tolerable step and touch voltage	4	BB, PPT
	Week 10	Actual Touch and step voltages Design of earthing grid Part II Tower footing resistance, Measurement of soil resistivity	5	BB, PPT
	Week 11	Impulse behavior of earthing Systems Neutral earthing. Problems	5	BB, PPT
	Week 12	Types of distribution systems, arrangements, selection and size of feeders using Kelvin's law design of cables in distribution systems considering ampere capacity voltage drop during starting and running load	5	BB,PPT, MATLAB tool
	Week 13	primary distribution design secondary distribution design Distribution substation, Calculation of distributor size and its examples,	6	BB, PPT
	Week 14	calculation of voltage drops and size of distributor, Voltage regulation and lamp flicker Design of rural distribution, Planning and design of town electrification scheme Design of industrial distribution system	6	BB,PPT, MATLAB Tool
	Week 15	Economics Of Distribution System: Comparison of overhead-transmission and distribution system, Effect of voltage, Selection of equipment, Economic size of power apparatus Economic selection of distribution system Power transmission and distribution cost, Energy losses in distribution system.	6	BB, PPT



Elective-I: Advanced Control Theory, Industrial Automation, Soft Computing
Elective-II: Electrical Power Quality, EHV AC & DC, Special Machines, MOOC
Elective-III: FACTS, Advanced Power Electronics, Power System Planning, MOOC

Subject: Power System Design								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0719**				**Semester: VII**
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	0	3	60		40		100

Perquisites:

Power System I

Power System II

High Voltage Engineering

Course Objectives:

(xiii) To understand different types of Transmission lines

(xiv) To provide knowledge of transmission line parameters.

(xv) To understand the Concept of HVDC system

(xvi) To understand the concept of EHV transmission line design.

(xvii) To understand the Sizing and requirement of substation.

(xviii) To understand different configuration of cables for Distribution System

Course Outcome:

After the end of the course the students will be able to

7. Design 3 phase Transmission line and related parameters
8. Design HVDC System.
9. Design the substation and different bus-bar schemes.
10. Analysis of electrical and mechanical design parameters
11. Calculate the cable sizing , feeder sizing and Voltage regulation for Distribution System design
12. Design EHV line based on bundle conductors and Design of EHV towers

SYLLABUS

UNIT-I **[09]**

Design of HVDC Transmission Lines:

Introduction, Limitations of high voltage a.c. transmission, Advantaged and limitations of HVDC transmission, Principle of control of HVDC transmission, Applications of HVDC system.

Design of Substation:

Substation layout, selection of sizes and locations of sub stations, Substation equipments specifications ratings and its operation from design view point, selection of size and location of generating stations, Interconnection.

UNIT-II **[12]**

Power System Earthing:

Objectives, Definitions, Tolerable limits of body currents, Soil resistivity, Earth resistance, Tolerable step and touch voltage , Actual Touch and step voltages, Design of earthing grid, Tower footing resistance, Measurement of soil resistivity and earth resistance, Impulse behavior of earthing Systems, Neutral earthing.

UNIT-III **[12]**

Design of Distribution System:

Types of distribution systems, arrangements, selection and size of feeders using Kelvin's law, design of cables in distribution systems considering ampere capacity, voltage drop during starting and running load, primary distribution design, secondary distribution design, Distribution substation, Calculation of distributor size and its examples, calculation of voltage drops and size of distributor, Voltage regulation and lamp flicker, Design of rural distribution, Planning and design of town electrification scheme, Design of industrial distribution system. Economics Of Distribution System**:** Comparison of overhead-transmission and distribution system, Effect of voltage, Selection of equipment, Economic size of power apparatus, Economic selection of distribution system, Power transmission and distribution cost, Energy losses in distribution system.

UNIT-IV **[12]**

Transmission Line Design:

Electrical design of transmission line, Design philosophy, voltage level selection and choice of conductors, spacing of conductor and corona, insulators and SIL, design problem. Mechanical design of transmission line Considerations, loading on conductors, span, sag and tension clearance, stringing, problems. Transmission line tower design, Location of tower, Earth wires, Reduction of tower footing resistance, examples.EHV Transmission Line Design Considerations, selection, spacing of conductors, corona and radio interference, shunt and series compensation, tuned power lines,

insulation coordination and different types of EHV towers, EHV systems in India.

Text Book

3. Electrical Power System Design :M. V. Deshpande, TMH publication
4. Electrical Power System Design :B. R. Gupta, S. CHAND

Reference Book

1. A course in Electrical Power: Soni,Gupta and Bhatnagar, Dhanpat Rai & Sons
2. Substation Design: Satnam & Gupta, DhanpatRai and Co.
3. Electrical Power System Planning A. S. Pabla, TMH publication

Web Resource

https://www.vssut.ac.in/lecture_notes/lecture1424265031.pdf

MOOCS:

iv) https://www.edx.org/
v) https://www.nptel.ac.in/
vi) https://www.coursera.org/

Name of Institute: IITE
Name of Faculty: Dr. Sweta Shah

Course code: EL0720
Course name: Power System Planning
Pre-requisites: Power system I, Power System II, Switch gear and Protection
Credit points: 4
Offered Semester: 7th

Course Coordinator
Full Name: Dr. Sweta Shah
Department with siting location: Electrical Engineering Department, 3rd floor Bhawar Building. Project & Design Lab
Telephone: 9979884434
Email: swetashah.el@ indusuni.ac.in
Consultation times: 3:45 – 4:20 p.m.

Course Lecturer
Full Name: Dr. Sweta Shah
Department with siting location: Electrical Engineering Department, 3rd floor Bhawar Building. Project & Design Lab
Telephone: 9979884434
Email: swetashah.el@ indusuni.ac.in
Consultation times: 3:45 – 4:20 p.m.

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Objectives

By participating in and understanding all facets of this Course a student will:

(xix) To understand fundamental concept of load forecasting
(xx) To learn requirements of load forecasting
(xxi) To understand Load pattern and load curve calculation.
(xxii) Analysis of load pattern and planning for load dispatch / scheduling.
(xxiii) To understand the planning for generation.
(xxiv) To understand different configuration of long & short term load forecasting.

Course Outcomes (CO)

1. List different techniques of load forecasting.
2. Recognize load demand based on numerical method.
3. Calculate load demand / load factors based on priority.
4. Analysis of load pattern and planning for load dispatch / scheduling.
5. Prepare and calculate for long term & short term load forecasting

Course Outline

Proposed course mainly deal with Transmission line design, HVDC system Design, Distribution System and its configuration and substation design

Method of delivery

Face to face lectures

Study time

3 lectures + 2 Tutorial / week

CO-PO Mapping (PO: Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			1			1					
CO2	3	1		1	2							
CO3	3	2		2	2		1					
CO4	2		3		1							
CO5	2	1	3				1					
CO6	2		3		1							

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

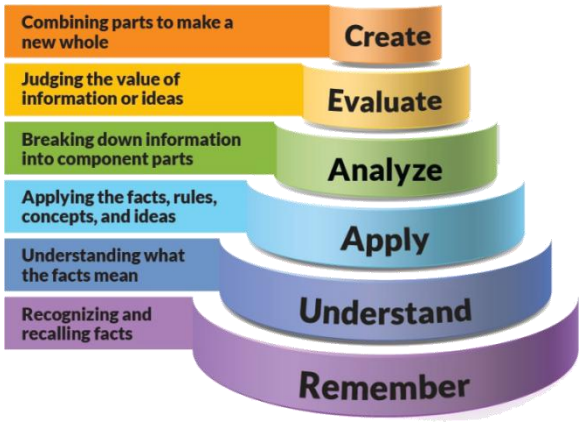


Figure 1: Blooms Taxonomy

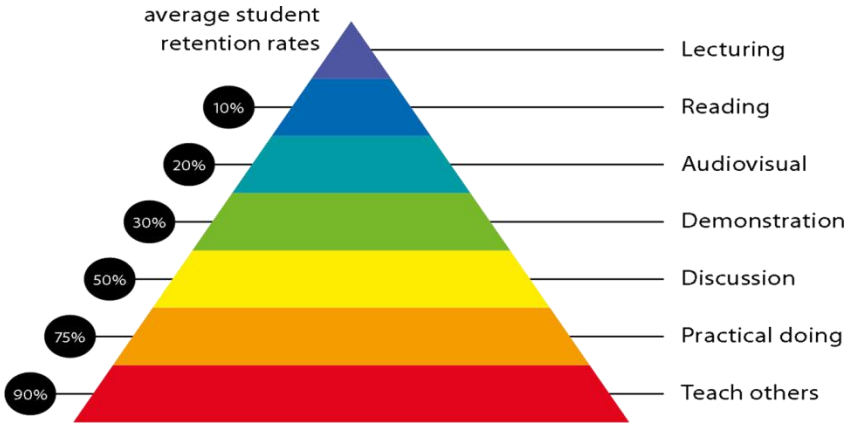


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply	**4 Problem solving skills**

creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Lecture/tutorial times

(Give lecture times in the format below)

Lecture : Monday 9- 10 AM
Lecture : Tuesday 10 - 11 AM
Lecture : Thursday 2 -3 PM

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

Details of referencing system to be used in written work

Text books

1. Makridakis, Spyros, “Forecasting methods and application”, John Wiley, 1993.
2. X.Wang & J.R. Mc Donald , “Modern Power system planning”, McGraw. Hill, 1993
3. A.S Pabla , “Electrical Power system planning”, Mac Millan,Delhi,1998

Additional Materials

4. Sullivan, “Power system planning”, McGraw. Hill ,1977

Lakervi E, E J Holmes, “Electricity distribution

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Theory

CIE 60 marks (40 marks mid semester examination + 20 marks internal evaluation)

Components of internal evaluation
05 marks as attendance bonus for all students having attendance > 80%
05 marks for presentation
10 marks for assignment or case studies

End Term Examination: 40 marks

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

-

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -1% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

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Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

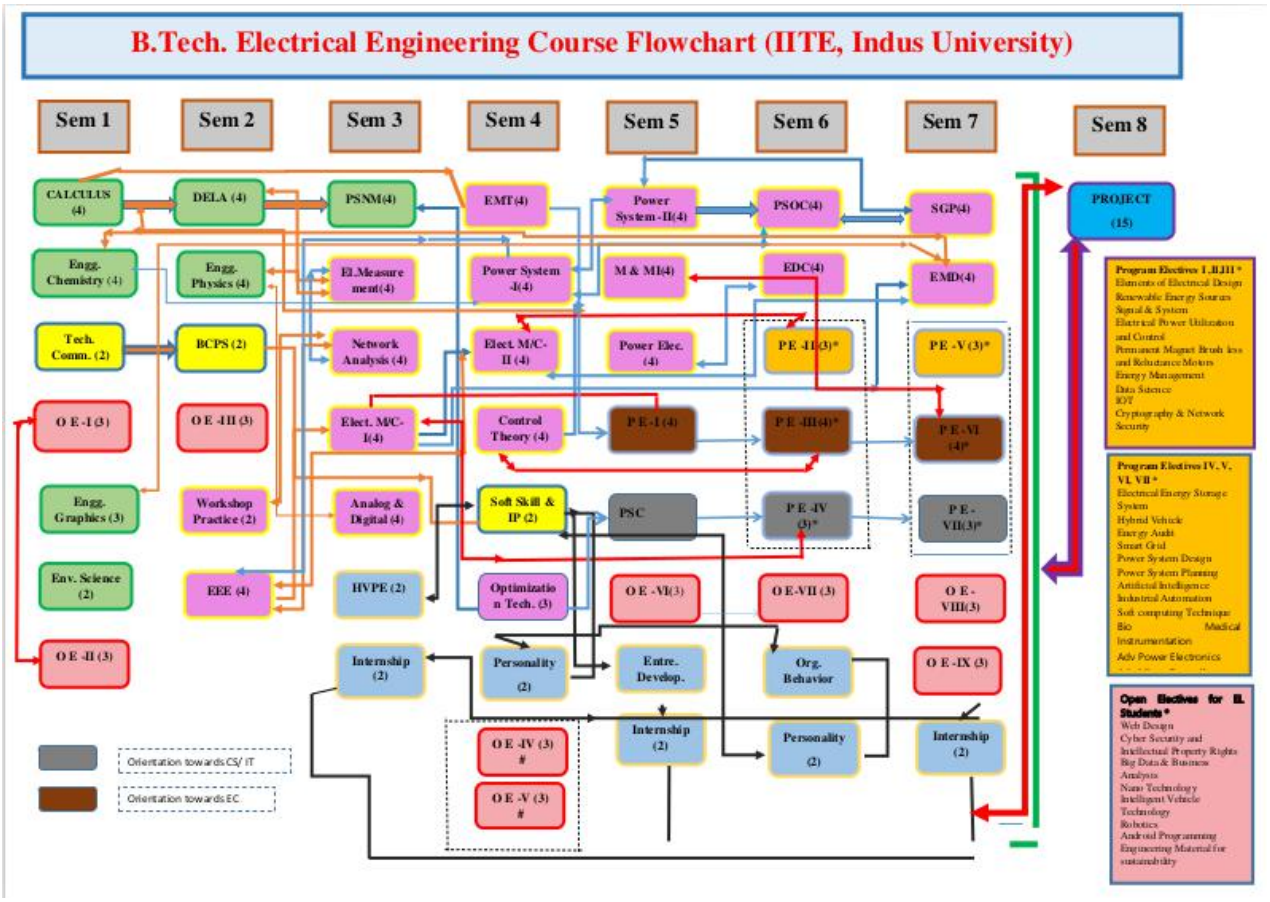
.

Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Current Status Of Forecasting, Fundamentals Of Quantitative Forecasting, Explanatory And Time Serious Forecasting	1	BB, PPT
	Weeks 2	Least Square Estimates, Peak Load Forecasting, Accuracy of Forecasting Methods,	1	BB, PPT
	Week 3	Regression Methods, Box Jenkins Time Serious Methods.	2	BB, PPT
	Week 4	Problems facing electricity industry, Long term forecasting techniques	2	BB, PPT
	Week 5	Methods of long term forecasting,	3	BB, PPT
	Week 6	Spatial load forecasting,,Multivariate procedures	3	BB, PPT,
	Week 7	Short term forecasting techniques	3	BB, PPT
	Week 8	The role of forecasting in planning, Comparison and selection of forecasting methods,	4	BB, PPT,
	Week 9	The accuracy of forecasting methods	4	BB, PPT
	Week 10	Pattern of the Data and its effects on individual forecasting methods	5	BB, PPT
	Week 11	Time horizon effects on forecasting methods.	5	BB, PPT

	Week 12	Fundamental economic analysis	5	BB,PPT,
	Week 13	Generation planning optimized according Network expansion planning	6	BB, PPT
	Week 14	distribution & Transmission system planning.	6	BB,PPT,
	Week 15	Reactive power planning	6	BB, PPT


B.Tech. Electrical Engineering Course Flowchart (IITE, Indus University)
Sem 1
Sem 2
Sem 3
Sem 4
Sem 5
Sem 6
Sem 7
Sem 8
CALCULUS (4)
DELA (4)
PSNM(4)
EMT(4)
Power System -II(4)
PSOC(4)
SGP(4)
PROJECT (15)
Engg. Chemistry (4)
Engg. Physics (4)
EL.Measurement(4)
Power System -I(4)
M & MI(4)
EDC(4)
EMD(4)
Tech. Comm. (2)
BCPS (2)
Network Analysis (4)
Elect. M/C-II (4)
Power Elec. (4)
PE -II (3)*
PE -V (3)*
O E -I (3)
O E -III (3)
Elect. M/C-I(4)
Control Theory (4)
P E -I (4)
P E -III(4)*
P E -VI (4)*
Engg. Graphics (3)
Workshop Practice (2)
Analog & Digital (4)
Soft Skill & IP (2)
PSC
P E -IV (3)*
P E - VII(3)*
Env. Science (2)
EEE (4)
HVPE (2)
Optimization Tech. (3)
O E -VI(3)
O E-VII (3)
O E - VIII(3)
O E -II (3)
Internship (2)
Personality (2)
Entre. Develop.
Org. Behavior
O E -IX (3)
O E -IV (3) #
O E -V (3) #
Internship (2)
Personality (2)
Internship (2)
Orientation towards CS/ IT
Orientation towards EC
Program Electives I, II,III *
Elements of Electrical Design
Renewable Energy Sources
Signal & System
Electrical Power Utilization and Control
Permanent Magnet Brush less and Reluctance Motors
Energy Management
Data Science
IOT
Cryptography & Network Security
Program Electives IV, V, VI, VII *
Electrical Energy Storage System
Hybrid Vehicle
Energy Audit
Smart Grid
Power System Design
Power System Planning
Artificial Intelligence
Industrial Automation
Soft computing Technique
Bio Medical Instrumentation
Adv Power Electronics
Open Electives for EL Students *
Web Design
Cyber Security and Intellectual Property Rights
Big Data & Business Analysis
Nano Technology
Intelligent Vehicle Technology
Robotics
Android Programming
Engineering Material for sustainability

Subject: Power System Planning								
Program: B.Tech. Electrical Engineering				Subject Code: EL0720				Semester: VII
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	0	3	40	0	60	0	100

Perquisites:

iv) Basic Electrical Engineering

v) Knowledge of Electrical Power System

vi) Knowledge of optimization techniques

Course Objective:

i) To analyze and evaluate an electric power system for generation planning and load forecasting, and

ii) To execute production costing analysis and long term generation expansion plans in power system

Course Outcome:

13. Learn the different types of planning methods
14. Learn economic aspects in planning.
15. Learn about substation planning
16. Learn about generation expansion planning
17. Learn about reactive power planning
18. Learn about power system planning under uncertainties.

SYLLABUS

UNIT-I

Power System Planning, Basic Principles

Power System Elements, Power System Structure, Power System Studies, a Time-horizon Perspective, Power System Planning Issues, Static Versus Dynamic Planning, Transmission Versus Distribution Planning, Long-term Versus Short-term Planning, Basic Issues in Transmission Planning.

Economic Principles

Definitions of Terms, Cash-flow Concept-Time Value of Money, Economic Terms. Economic Analys- Present Worth Method, Annual Cost Method, Rate of Return Method, Examples.

UNIT-II

Load Forecasting

Load Characteristics, Load Driving Parameters, Spatial Load Forecasting, Long Term Load Forecasting Methods, Trend Analysis, Econometric Modeling, End-use Analysis, Combined Analysis, Load Forecasting for a Regional Utility, Load Forecasting of a Large Scale Utility.

Single-bus Generation Expansion Planning

Problem Definition, Problem Description, Mathematical Development, Objective Functions, Constraints, WASP, a GEP Package, Calculation of Costs, Description of WASP-IV Modules.

Multi-bus Generation Expansion Planning

Problem Description, A Linear Programming (LP) Based GEP, Basic Principles, Mathematical Formulation, A Genetic Algorithm (GA) Based GEP.

UNIT-III

Substation Expansion Planning.

Problem Definition, Basic Case. Problem Description, Typical Results for a Simple Case, Mathematical View, Objective Function, Constraints, Problem Formulation, Required Data, An Advanced Case, General Formulation, Solution Algorithm, System Under Study, Load Model, Downward Grid, Upward Grid, Transmission Substation, Results for BILP Algorithm, Results for GA.

Network Expansion Planning.

Problem Definition, Problem Description, Problem Formulation, Objective Function, Constraints, Solution Methodologies, Enumeration Method, Heuristic Methods, Numerical Results, Garver Test System, A Large Test System.

Unit-IV

Reactive Power Planning

Voltage Performance of a System, Voltage Profile, Voltage Stability, Voltage Performance Control Parameters, Static Versus Dynamic Reactive Power Resources, Problem Description, Reactive Power Planning (RPP) for a System, Static Reactive Resource Allocation and Sizing, Dynamic Reactive Resource Allocation and Sizing, Solution Procedure, Numerical Results, Small Test System, Large Test System

Power System Planning in the Presence of Uncertainties

Power System De-regulating, Power System Uncertainties, Uncertainties in a Regulated Environment, Uncertainties in a De-regulated Environment, Practical Issues of Power System Planning in a De-regulated Environment, How to Deal with Uncertainties in Power System Planning, Expected Cost Criterion, Min-max Regret Criterion, Laplace Criterion, The Van Neuman–Morgenstern (VNM) Criterion, Hurwicz Criterion.

Text Book

1. Electric Power System Planning: Issues, Algorithms and Solutions, Hossein Seifi, Mohammad Sadegh Sepasian, Springer, 2011.
2. Power System Planning Technologies and Applications: Concepts, Solutions and management, Elkarmi, Fawwaz, Engineering Science Reference, 2012

Reference Book

1. Power System Engineering: Planning, Design, and Operation of Power Systems and equipments, Juergen Schlabbach, Karl-Heinz Rofalsk, Wiley VCH, 2014
2. Probabilistic Transmission System Planning, Wenyuan Li, Wiley, IEEE Press, 2011
3.

Web Resource

i) https://slideplayer.com/slide/5291948/
ii) https://www.youtube.com/watch?v=eVmXBXO-w-8
iii) https://www.youtube.com/watch?v=gqMyAzAvzqM

MOOCS:

vii) https://www.edx.org/
viii) https://www.nptel.ac.in/
https://www.coursera.org/

Name of Institute: Indus Institute of Technology & Engineering
Name of Faculty:

Course code: EL0723
Course name: Soft Computing Technique

Pre-requisites:

I) Switching Theory and Logic Design
Ii) Basic knowlegde of different types of gates

Credit points: 04

Offered Semester: VII

Course coordinator (weeks 01 - 15)
Full name:
Department with siting location: 3rd floor, Bhawar Building
Telephone:
Email:
Consultation times: 4:00 p.m. to 5:00 p.m.

Course lecturer (weeks 01 - 15)
Full name:
Department with siting location: 3rd floor, Bhawar Building
Telephone:
Email:
Consultation times: 4:00 p.m. to 5:00 p.m.

Students will be contacted throughout the session via mail with important information relating to this course.

Course Objectives

To introduce the concepts in Soft Computing such as Artificial Neural Networks, Fuzzy logic based systems, genetic algorithm-based systems and their hybrids

Course Outcomes (CO)

CO-1: Learn about soft computing techniques and their applications
CO-2: Analyze various neural network architectures.
CO3: Define the fuzzy systems.
CO4: Understand the genetic algorithm concepts and their applications.
CO5: Identify and select a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution.
CO6: Design systems with application of soft computing.

Method of delivery

Face to face lectures, Assignments, Quiz

Study time

Theory of 3 hours and practical of 2 hours

CO-PO Mapping (PO: Program Outcomes)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	1	1	3		1							
CO2	2	1	3	1								
CO3	3	1	1									
CO4	2	3	2									
CO5	2	2	1									
CO6	1	3	2									

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

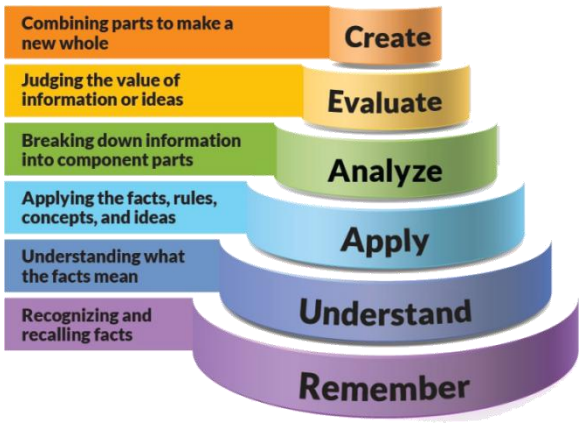


Figure 1: Blooms Taxonomy

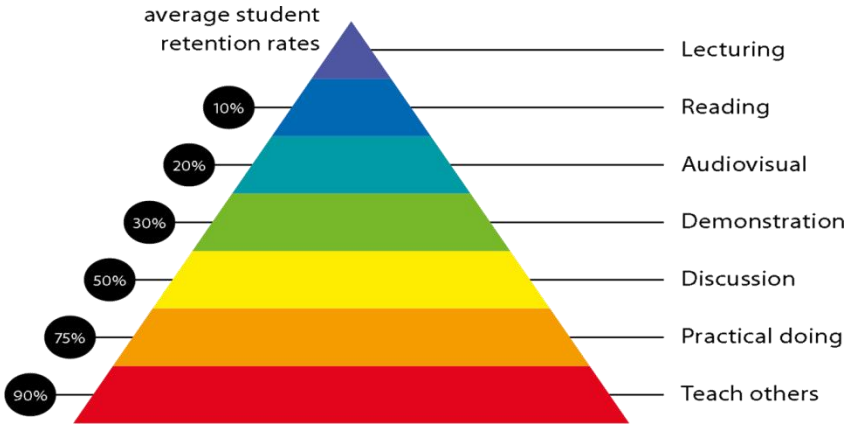


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**

Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

Designing based on MATLAB program

Lecture/tutorial times

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

Details of referencing system to be used in written work

Text books

1. Timothy J.Ross, Fuzzy Logic with Engineering Applicatios, McGraw-Hill

2. Neural Networks, Fuzzy Logic And Genetic Algorithm: Synthesis And Applications by S. Rajasekaran, G. A. Vijayalakshmi Pai

3. J.M. Zurada, .Introduction to artificial neural systems., Jaico Publishers

Additional Materials

4. H.J. Zimmermann, Fuzzy set theory and its applications., III Edition, Kluwer Academic Publishers, London.

5. Suran Goonatilake, Sukhdev Khebbal (Eds), .Intelligent hybrid systems., John Wiley & Sons, New York, 1995

6. Goldberg, D. E, Genetic algorithm in search, optimization and machine learning,Addison-Wesley, Reading Mass.

7. Kalyanmoy Deb, Optimization for Engineering Design – Algorithms and examples, PHI, New Delhi, ISBN-81-203-0943-x.

8. Simon Haykin, Neural Netwroks, PrenticeHall

SSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

Design sheets , MATLAB based Machine Design

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

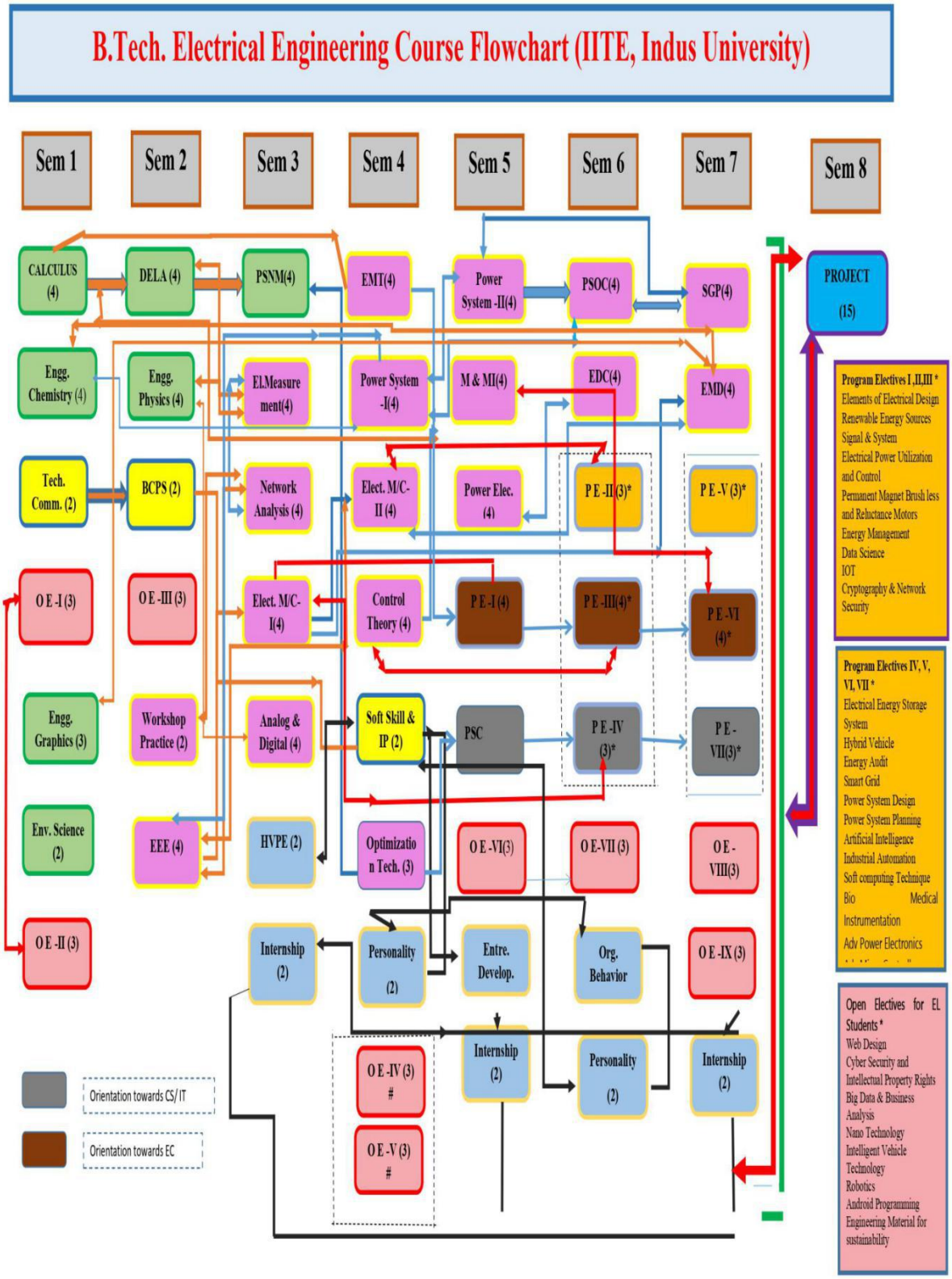
.

Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Introduction, GA terminology, selection methods,	2	BB
	Week 2	Introduction, GA terminology, selection methods,	2	BB
	Weeks 3	cross over methods, mutation methods, flow chart of genetic Algorithm,	2	BB
	Week 4	problems based on GA.	1	BB
	Week 5	Concepts of uncertainty and imprecision, sets, concepts, properties and operations on classical sets & fuzzy sets, classical & fuzzy relations, membership functions	1	BB
	Week6	Concepts of uncertainty and imprecision, sets, concepts, properties and operations on classical sets & fuzzy sets, classical & fuzzy relations, membership functions	*1*	BB
	Week7	uzzy logic, fuzzification, fuzzy rule based systems,	1	BB
	Week 8	fuzzy propositions, and applications.		BB
	Week 9	Basics of ANN: Models of a Neuron, Topology, Multi Layer Feed Forward Network (MLFFN)	2	BB
	Week 10	Radial Basis Function Network (RBFN), Recurring Neural Network (RNN), learning processes:		BB
	Week 11	supervised and unsupervised learning. error-correction learning, Hebbian learning;		BB
	Week 12	Single layer perceptrons, multilayer perceptrons,		BB
	Week 13	east mean square algorithm, Mc-		BB

		culloch pits neuron, linear separability concept,		
	Week 14	Hebb's rule, Perceptron network, learning rule, flow chart,		BB
	Week 15	Adaptive linear neuron, back propagation algorithm applications.		BB



Name of Institute: Indus Institute of Technology & Engineering
Name of Faculty: Dr. Sweta Shah

Course code: EL0716
Course name: Switchgear and protection
Pre-requisites:
Basics of Electrical Engineering, Power System
Credit points: 04
Offered Semester: VII

Course Coordinator
Full Name: Dr. Sweta Shah
Department with siting location: Electrical Engineering Department, 3rd floor Bhawar Building.
Project & Design Lab
Telephone: 9979884434
Email: swetashah.el@ indusuni.ac.in
Consultation times: 3:45 – 4:20 p.m.

Course Lecturer
Full Name: Dr. Sweta Shah
Department with siting location: Electrical Engineering Department, 3rd floor Bhawar Building.Project & Design Lab
Telephone: 9979884434
Email: swetashah.el@ indusuni.ac.in
Consultation times: 3:45 – 4:20 p.m.

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Objectives

By participating in and understanding all facets of this Course a student will:

10) Be able to develop understanding for basic arc interruption theory.
11) Be able to understand arc extinguishing process in various types of CB
12) Understand applications of various CB and their comparison.
13) Be able to provide the understanding of basic requirements of protection systems.
14) Understand the construction and working of various types of relays

Course Outcomes (CO)

CO 1: Students will able to understand the physic of arc interruption and will able to know concept of various CB mechanism and operating principles

CO 2: Students will able to apply comparative study for selection of CB

CO 3: The student can understand the necessity of requirements of Power system Protection and importance of relay selection and factors affecting it.

CO 4: Student will be able to apply relay coordination of interconnected system and testing of relays.

CO 5: Students will be able to discriminate the between healthy and faulty condition of apparatus and implementation of practical schemes and associated calculations

CO 6: Students will be able to analyze the fault behavior with different grounding methods

.Course Outline

This course mainly deals with different types of Power system protection against different types of the faults. It covers how the reactive beahviour achieved with different construction of the protective relay and how to protect various power system components like transmission lines, transformers, motors, generators and distribution networks.

Method of delivery

Face to face lectures

Study time

4 Hour Lecture and 2 Hour practical per week

CO-PO Mapping (PO: Program Outcomes)

Mapping CO's with PO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	2	2	1	1	1	1	-	1	1	-	2
CO2	3	2	2	1	1	1	1	-	1	1	-	2
CO3	3	3	3	2	2	1	1	1	1	1	1	2
CO4	3	3	3	3	2	1	1	2	2	1	1	2
CO5	3	2	2	1	1	1	1	-	1	1	-	2
CO6	3	3	3	2	2	1	1	1	1	1	1	2

1-Lightly Mapped 2- Moderately Mapped 3- Highly Mapped

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

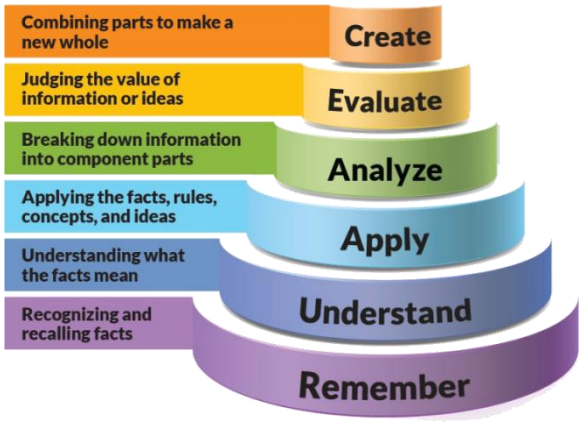


Figure 1: Blooms Taxonomy

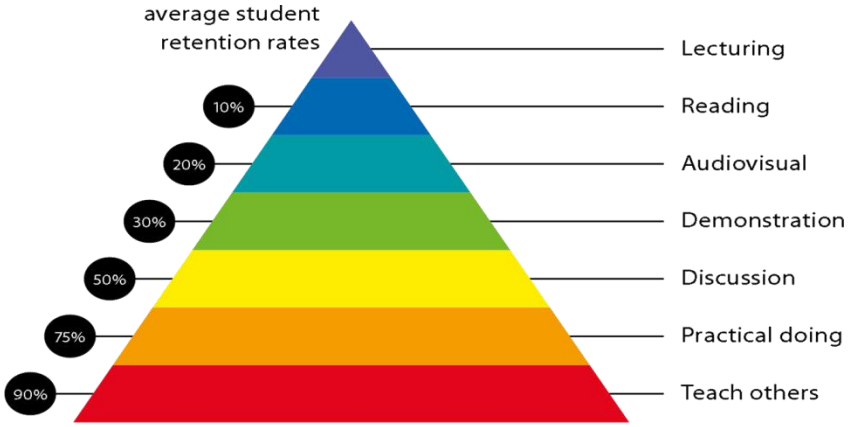


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies.	**2 Information literacy, gathering & processing**

Acknowledge the work and ideas of others.	
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

(Mention what practical work this Course involves)

Lecture/tutorial times

(Give lecture times in the format below)

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

Details of referencing system to be used in written work

Text books

7. Power System Protection and Switchgear-Oza, Nair, Mehta, Makwana/TMH/2010.
8. Power System Protection and Switchgear , Badri Ram &Vishvakarma, TMH
9. Protective Relays – Theory & Practice Vol I, II, A R Van C Warington, Chapman & Hall.
10. Principles of Power Systems V.K Mehta-S Chand

Additional Materials

11. JNP switchgear Handbook, R.T. Lythall,Newnes Butterworth
12. Switchgear and protection, J.B. Gupta, S. K. Kataria
13. Digital Protection, L. P. Singh, Willey Eastern

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Example:

Class Test	20% (week 4)	Objective (1-3)
Quiz	10% (week 8)	Objective (1-4)
Assignment	20% (due week 10)	As per IU format
Class Participation	10%	
Final exam (*closed book*)	40%	As per IU format

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

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Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

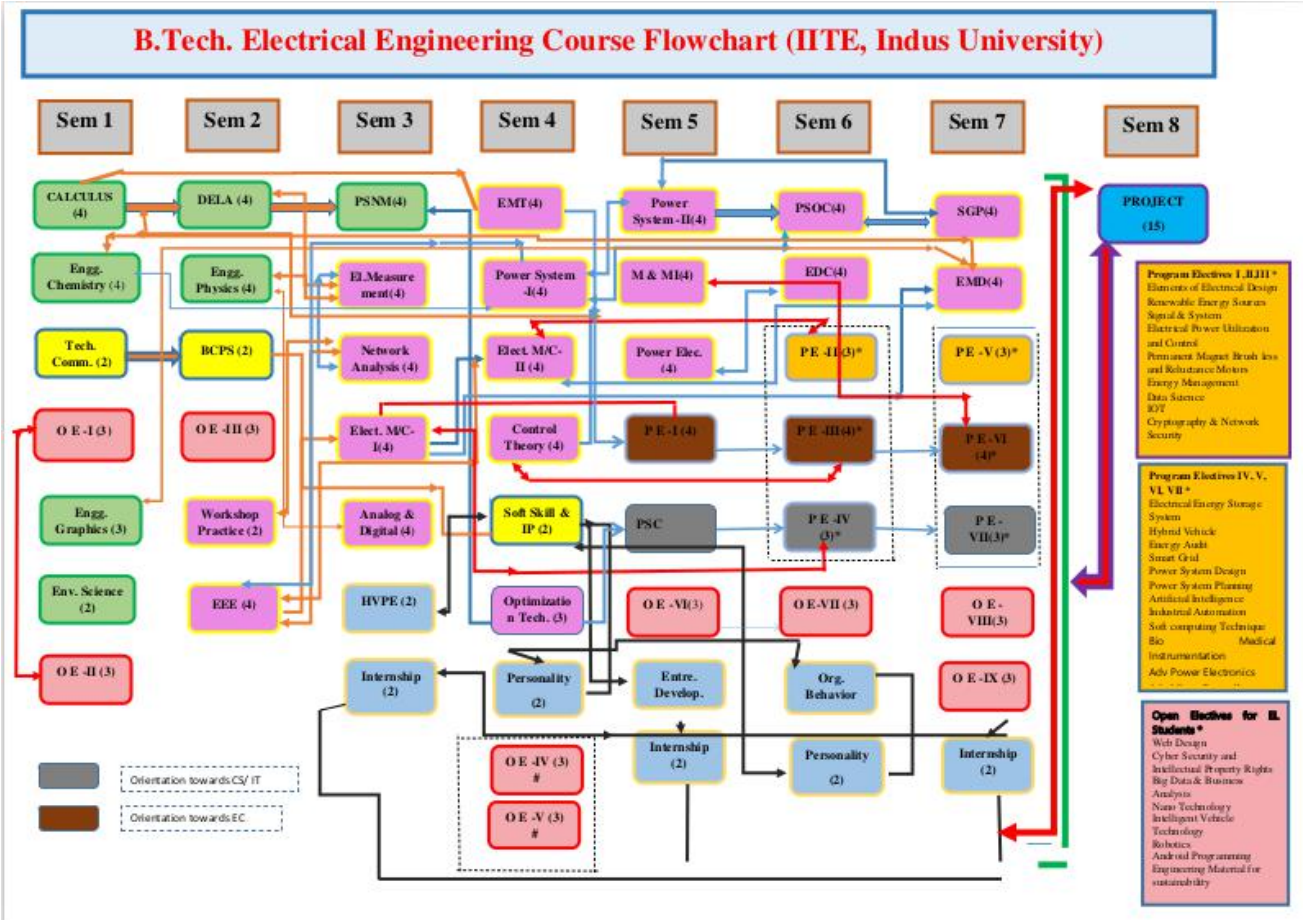
.

Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Elementary principles of arc interruption, Recovery, Restriking Voltage and Recovery voltages, Restriking Phenomenon. RRRV,	CO1	Chalk & Talk
	Weeks 2	Current Chopping and Resistance Switching, Circuit Breaker ratings and Specifications, Fuse material, HRC fuse, liquid fuse, Application of fuse.,	CO1	Chalk & Talk
	Week 3	Description and Operation of: Air Break Circuit Breaker, Air Blast Circuit breakers, Interruption methods, Description and Operation of: Bulk oil circuit breaker, single and multi-break construction, Description and Operation of: Minimum oil circuit breaker, Voltage distribution in oil circuit breakers with arc control devices,	CO1,	Chalk & Talk
	Week 4	Fault statistic, basic protection scheme, Zones of protection, basic terminology. Basic requirements, Types of protection schemes,	CO1, CO2	Chalk & Talk
	Week 5	Relay Classification, Construction & Operations of Electromagnetic Relays, Construction & Operations of Electromagnetic Relays,-2	CO1, CO2, CO3	Chalk & Talk
	Week 6	Construction & Operations of Static Relays Construction & Operations of Microprocessor based Relays.	CO5	Chalk & Talk
	Week 7	Basic line protections, methods of discrimination, Rules for relay settings, problems in overcurrent relays, Directional overcurrent and earth fault protection schemes, Problems in directional protection,	CO3, CO4, CO5	Chalk & Talk

	Week 8	Distance protection, problems in distance measurement, Pilot wire protection scheme, carrier current protections	CO3,CO4,CO5	Chalk & Talk
	Week 9	Protection of transformers, Buchholtz relay Protection. Percentage Differential Protection,	C05, CO6	Chalk & Talk
	Week 10	Numerical Problem on Design of CT s Ratio, Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions.	C05, CO6	Chalk & Talk
	Week 11	Restricted Earth fault and Inter-turn fault Protection. Bus-zone protection-requirements, Non-unit protection, unit protections-frame earth protection breaker back up protection	CO1, CO2, CO5, CO6	Chalk & Talk
	Week 12	Various differential protections, (High and Low impedance) Induction Motor Protection, ,	C05, CO6	Chalk & Talk
	Week 13	Grounded and Ungrounded Neutral Systems, Effects of Ungrounded Neutral on system performance. Arcing Grounds and Grounding Practices.	CO1, CO2, CO5, CO6	Chalk & Talk
	Week 14	Installation and commissioning tests, Special tests, overshoot tests, accuracy tests, range tests and stability tests,	CO4, CO6	Chalk & Talk
	Week 15	Feeder and bus bar protection, Transmission line protection, Distance scheme.	CO4,CO6	Chalk & Talk


B.Tech. Electrical Engineering Course Flowchart (IITE, Indus University)
Sem 1
Sem 2
Sem 3
Sem 4
Sem 5
Sem 6
Sem 7
Sem 8
CALCULUS (4)
DELA (4)
PSNM(4)
EMT(4)
Power System -II(4)
PSOC(4)
SGP(4)
PROJECT (15)
Engg. Chemistry (4)
Engg. Physics (4)
EI.Measurement(4)
Power System -I(4)
M & MI(4)
EDC(4)
EMD(4)
Tech. Comm. (2)
BCPS (2)
Network Analysis (4)
Elect. M/C-II (4)
Power Elec. (4)
PE -II (3)*
PE -V (3)*
O E -I (3)
O E -III (3)
Elect. M/C-I(4)
Control Theory (4)
P E -I (4)
P E -III(4)*
P E -VI (4)*
Engg. Graphics (3)
Workshop Practice (2)
Analog & Digital (4)
Soft Skill & IP (2)
PSC
P E -IV (3)*
P E - VII(3)*
Env. Science (2)
EEE (4)
HVPE (2)
Optimization Tech. (3)
O E -VI(3)
O E-VII (3)
O E - VIII(3)
O E -II (3)
Internship (2)
Personality (2)
Entre. Develop.
Org. Behavior
O E -IX (3)
O E -IV (3) #
Internship (2)
Personality (2)
Internship (2)
O E -V (3) #
Orientation towards CS/ IT
Orientation towards EC
Program Electives I ,II,III *
Elements of Electrical Design
Renewable Energy Sources
Signal & System
Electrical Power Utilization and Control
Permanent Magnet Brush less and Reluctance Motors
Energy Management
Data Science
IOT
Cryptography & Network Security
Program Electives IV, V, VI, VII *
Electrical Energy Storage System
Hybrid Vehicle
Energy Audit
Smart Grid
Power System Design
Power System Planning
Artificial Intelligence
Industrial Automation
Soft computing Technique
Bio Medical Instrumentation
Adv Power Electronics
Open Electives for EL Students *
Web Design
Cyber Security and Intellectual Property Rights
Big Data & Business Analysis
Nano Technology
Intelligent Vehicle Technology
Robotics
Android Programming
Engineering Material for sustainability

Subject: Switchgear & Protection								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0716**			**Semester: VII**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	40	40	60	60	200

Prerequisites:

1. Electric power system – generation, transmission and distribution
2. Electrical machines
3. Electrical measurements and instrument transformers

Course Objectives:

1. To develop understanding for basic arc interruption theory.
2. To understand arc extinguishing process in various types of CB, their selection and application
3. To provide the understanding of basic requirements of protection systems.and understand the construction and working of various types of relays
4. To be able to calculate settings and implementation schemes for power system and electrical apparatus

Course Outcome:

After the end of the course the students will be able to

1. Understand the physic of arc interruption and will able to know concept of various CB mechanism and operating principles
2. Apply comparative study for selection of CB as per application area
3. Understand the necessity and requirements of Power system
4. Protection and importance of relay selection and factors affecting it.
5. Apply relay coordination of interconnected system and various electrical apparatus
6. Discriminate the between healthy and faulty condition of

SYLLABUS

UNIT-I **[08]**

Low end Switchgear and Neutral Grounding

Re-wirable fuses, HRC fuses, isolators and earthing switches, selection of fuses. Effectively grounded and ungrounded systems, resonant grounding Methods of neutral grounding.

Basic Principles and Ratings Of Circuit Breakers

Arc phenomenon, arc Interruption theories, arc control devices, recovery and restriking voltages, current chopping, Interruption of capacitive current, resistance switching, circuit breaker operating mechanism and control systems, making current, breaking current symmetrical and unsymmetrical, continuous current rating, MVA capacity.

UNIT-II **[09]**

Circuit Breakers

Arc controlled devices, ACB, ABCB, SF_6 circuit breaker, vacuum circuit breaker and DC circuit breakers, circuit breaker ratings, auto re-closer. Testing of circuit Breaker.

Functions of Protective Relaying

Fundamental characteristics of relays, standard definition of relay terminologies, relay classifications, operating principles of single and double actuating quantity type electromechanical relays, directional relay, reverse power relay

UNIT-III **[11]**

Transformer Protection

Protection of transformers, basic differential over current relays, restricted earth fault protection, gas relays, overall generator-transformer differential protection, magnetizing inrush protection

Generator & Motor Protection

Modern methods of protecting generators against faults in stator, rotor and prime movers and other abnormal conditions. Abnormal operating conditions, under voltage, phase and earthfault, overload and unbalanced voltage protections for motors.

UNIT-IV **[14]**

Busbar Protection: Protection of out door and indoor bus bar by current differential, voltage differential and directional comparison principles, linear coupler, high impedance schemes.

Transmission Line Protection: Operating characteristics of impedance, reactance relays on R-X diagram, overreach and memory action, ohm and mho types relays and their characteristics, relay response under power swings and effect of fault resistance, setting of distance relays, Carrier Current Protection-Phase comparison and directional comparison principles.

Text Books

1. M. A. Date, B.Oza, N.C. Nair, “Power System Protection”, Bharti Prakashan,2004 .
2. J. Lewis Blackburn, “Protective Relaying”, Marcel Dekker INC. 1997

Reference Books

1. Network Protection Application Guide, GE technical publication

2. J B Gupta, "Switch Gear and Protection", S K KATARIA & SONS-NEW DELHI 2013
3. Van. C. Warrington A.R., "Protective Relays Vol. 1 & 2", Chapman & Hall, 1998.
4. T S Madhav Rao, "Power system protection static relays with microprocessor Applications", Tata McGraw hill Publication, 1998.
5. Badri Ram, D N Vishwakarma, "Power System Protection and Switchgear", Tata Mc Graw Hill, 2005.
6. Anderson P M, "Power System Protection", IEEE publication, 1999.
7. Walter -Marcel Dekker, "Protective relaying theory and applications", 2ed, Elmore, 2004. Russel Mason, "Art and Science of Protection relaying
8. Network Protection Application Guide, GE technical publication

Web resources

nptel.ac.in/downloads/108101039/

MOOCs

Name of Institute: IITE
Name of Faculty:

Course code: EL0730
Course name: Smart Grid
Pre-requisites: Power system I, Power System II, Switch gear and Protection
Credit points: 4
Offered Semester: 7th

Course Coordinator
Full Name:
Department with siting location: Electrical, 3rd floor
Telephone:
Email:
Consultation times: 3.45 to 4.20pm

Course Lecturer
Full Name:
Department with siting location: Electrical, 3rd floor
Telephone:
Email:
Consultation times: 3.45 to 4.20pm

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Objectives

By participating in and understanding all facets of this Course a student will:

1. A basic introduction to Smart Grid.
2. An understanding of the relevance of it in global perspective..
3. Technology needed.
4. Reforms and restructuring in Indian power sector.
5. Knowledge about intelligent and Strategic issues related to growth & development of Indian Power Business.

Course Outcomes (CO)

CO-1: To understand the basic concepts, components and architecture of smart grid

CO-2: To understand the various measurement technologies in smart grid

CO-3: To educate the importance of renewable energy in smart

CO-4: To know about battery technology and energy storage

CO-5: To brief about role of Electric Vehicles in smart grid

CO-6: To understand the difficulties of smart grid implementation

Course Outline

Proposed course mainly deal with Transmission line design, HVDC system Design, Distribution System and its configuration and substation design

Method of delivery

Face to face lectures

Study time

3 lectures + 2 Practical/week

CO-PO Mapping (PO: Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2			1						
CO2	3	2	2			2						
CO3	3	3	3			1						
CO4	3	3	3			1						
CO5	3	2	1			1						
CO6	3	3	3			2						

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

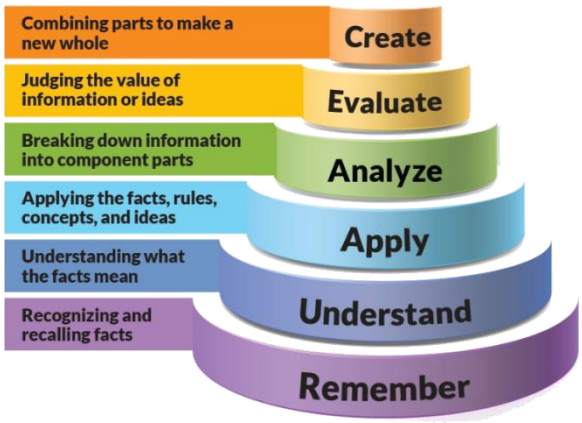


Figure 1: Blooms Taxonomy

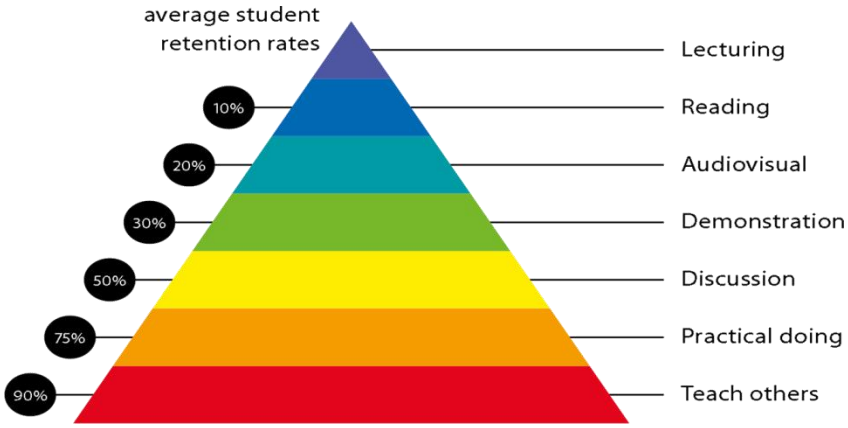


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

Lecture/tutorial times

(Give lecture times in the format below)

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

Details of referencing system to be used in written work

Text books

1. James Momoh, *Smart Grid: Fundamentals of Design and Analysis*, Wiley-IEEE Press
2. Buchholz, Bernd M., Styczynski, Zbigniew, *Smart Grids – Fundamentals and Technologies in Electricity Networks*, Springer Publishers
3. J. C. Stephens, E. J. Wilson, T. R. Peterson, *Smart Grid (R)Evolution*, Cambridge University Press
4. D. S. Kirschen and G. Strbac, *Fundamentals of Power System Economics*, John Wiley & Sons Ltd

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the

supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

-

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -1% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

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Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

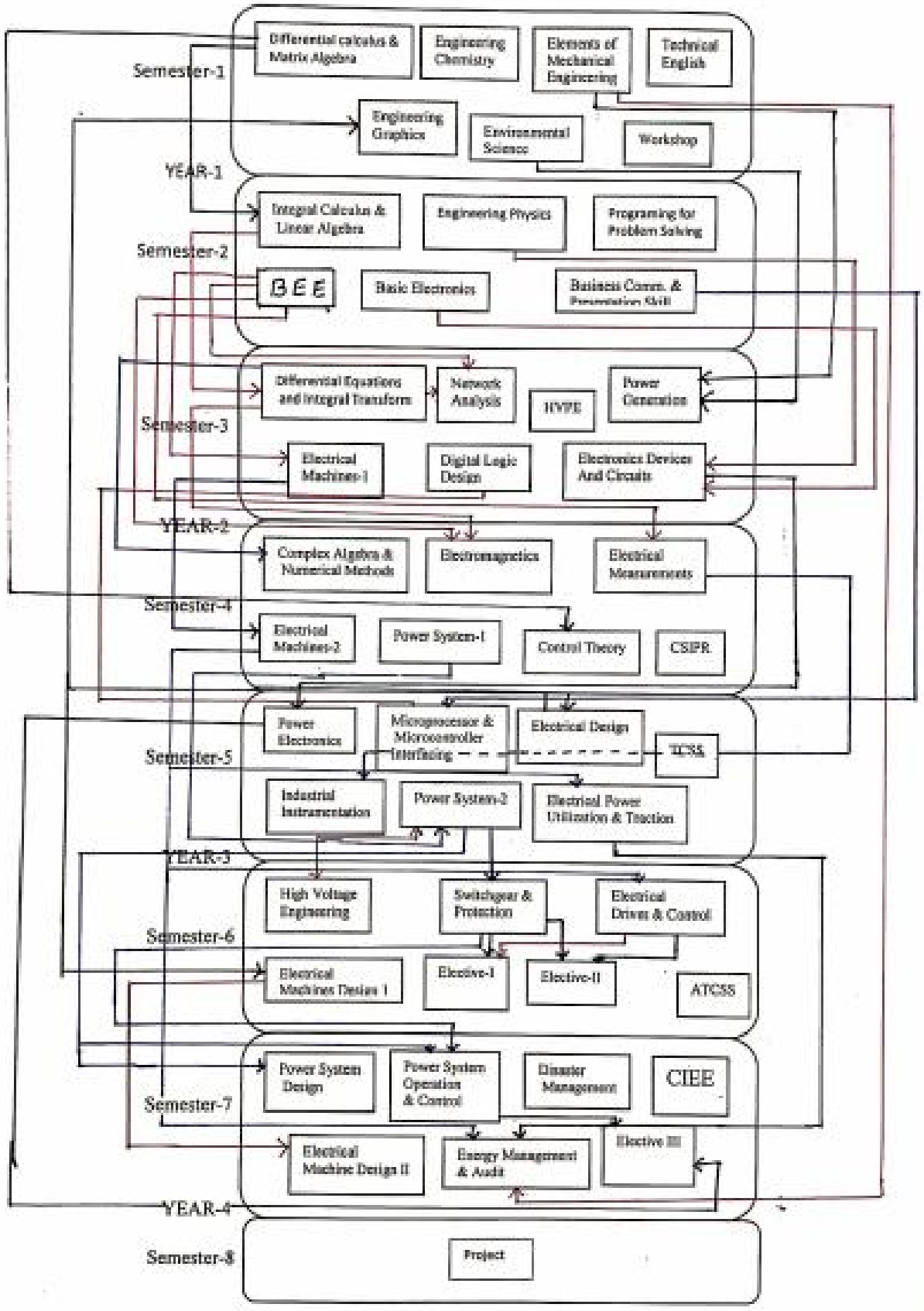
.

Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Basics of Power Systems: Load and Generation, Power Flow Analysis, Economic Dispatch and Unit Commitment Problems Smart Grid:	1	BB, PPT
	Weeks 2	Definition, Applications, Government and Industry, Standardization, Smart Grid Communications:	1	BB, PPT
	Week 3	Two-way Digital Communications Paradigm, Network Architectures, IP-based Systems, Power Line Communications, Advanced Metering Infrastructure	2	BB, PPT
	Week 4	Demand Response: Definition, Applications, and State-of-the Art, Pricing and Energy Consumption Scheduling, Controllable Load Models, Dynamics, and Challenges,	2	BB, PPT
	Week 5	Demand Response: Definition, Applications, and State-of-the Art, Pricing and Energy Consumption Scheduling, Controllable Load Models, Dynamics, and Challenges,	3	BB, PPT
	Week 6	Electric Vehicles and Vehicle-to-Grid Systems, Demand Side Ancillary Services, Renewable Generation and Resources: Carbon Footprint,		BB, PPT,
	Week 7	Wind and Solar, Micro-grid Architecture, Tackling Intermittency, Stochastic Models and Forecasting, Distributed Storage and Reserves	3	BB, PPT

	Week 8	Wide Area Measurement: Sensor Networks, Phasor Measurement Units, Communications Infrastructure,	4	BB, PPT, MATLAB tool
	Week 9	Wide Area Measurement: Sensor Networks, Phasor Measurement Units, Communications Infrastructure,	4	BB, PPT
	Week 10	Fault Detection and Self-Healing Systems, Applications and Challenges, Security and Privacy:	5	BB, PPT
	Week 11	Cyber Security Challenges in Smart Grid, Load Altering Attacks, False Data Injection Attacks, Defense Mechanisms, Privacy Challenges	5	BB, PPT
	Week 12	Cyber Security Challenges in Smart Grid, Load Altering Attacks, False Data Injection Attacks, Defense Mechanisms, Privacy Challenges	5	BB,PPT, MATLAB tool
	Week 13	Economics and Market Operations: Energy and Reserve Markets,	6	BB, PPT
	Week 14	Market Power, Generation Firms, Locational Marginal Prices, Financial Transmission Rights	6	BB,PPT, MATLAB Tool
	Week 15	Revision		BB, PPT



Elective-I: Advanced Control Theory, Industrial Automation, Soft Computing
Elective-II: Electrical Power Quality, EHV AC & DC, Special Machines, MOOC
Elective-III: FACTS, Advanced Power Electronics, Power System Planning, MOOC