Rajiv Gandhi University Of Knowledge Technologies-AP

Constituted under the Act 18 of 2008

NUZVID - RK VALLEY-SRIKAKULAM-ONGOLE

B. Tech Electrical and Electronics Engineering, Admitted Batch: 2020-21 and 2021-22

17-09-2022

Venue: I3- Administrative Block- Conference Hall Time: 11:00 AM

Board of Studies Meeting
Electrical and Electronics Engineering Department
Rajiv Gandhi University of Knowledge Technologies A.P.

Agenda of the meeting:

1. Proposed syllabus for the third and fourth year for the batch of 2020-24.

2. New curriculum for the upcoming batch of 2022-26.

3. Renaming the department of Electrical and Electronics Engineering (EEE) as

   Electrical Engineering (EE).

   Justification: At present, the department has its name Electrical & Electronics Engineering (EEE). It is suggested to rename the department as Electrical Engineering (EE) due to following reasons.

   a. Most of the premier institutions in the country like IITs and NIT's have EE instead of EEE. Whereas most of the private institutions in the country are using the title EEE.

   b. Having the name EE gives the major scope to diverge the field in various areas such as Computer science, AI, machine learning, IC design, Energy systems, VLSI, and signal processing.

   Since the department is at its initial stage, and to achieve the vision of reaching world-class standards, it is suggested to follow some of the aspects of premier institutions like IIT's where Electrical Engineering is the major department.

RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNOLOGIES

(Established through Act No.18 of 2008)
ANDHRA PRADESH, INDIA
(Catering to the Educational Needs of Gifted Rural Youth of Andhra Pradesh)

MINUTES OF THE MEETING OF THE BOARD OF STUDIES IN ELECTRICAL ENGINEERING OF RGUKT HELD AT 11:00A.M. ON 17-09-2022, IN THE CONFERENCE HALL, RGUKT NUZVID CAMPUS, KRISHNA DISTRICT, ANDHRA PRADESH.

MEMBERS PRESENT:

S. No	Name and designation	Role
1.	Dr. B. Lakshmana Rao, Dean Academics, Nuzvid campus	Member
2.	Sri. P. Shravani, Assistant Professor, Electrical Engineering department, Nuzvid campus	Chairperson
3.	Sri. J. Chakravarthi, HoD (I/c), Electrical Engineering department, Nuzvid campus	Member
4.	Sri. N. Ratnakar, Assistant Professor, Electrical Engineering department, Nuzvid campus	Member
5.	Dr. G. Jaya Raju, Assistant Professor, HoD (I/c), Electrical Engineering department, Srikakulam campus	Member
6.	Sri. S. Thanuja, pre-final year student, Electrical Engineering department, Nuzvid campus	Member

MEMBERS JOINED THE MEETING THROUGH GOOGLE MEET WEB APPLICATION

1.	Prof. Shanthi Pavan, Professor, Department of Electrical Engineering, IIT Madras	Member
2.	Prof. Krishna Vasudevan, Professor, Department of Electrical Engineering, IIT Madras	Member
3.	Sri. K. K Rai, Scientist-F, Technology Director Center for High Energy Systems and Sciences, DRDO	Member
4.	Dr. J. Ganeswara Rao, Deputy Director, Central Electricity Authority, Ministry of Power, India	Member
5.	Sri. D. Veera Vasanth, Silicon PnP Engineer, Intel Corporation	Member
6.	Sri. A. Sreekanth Reddy, HoD (I/c), Electrical Engineering department, RKV campus	Member

7.	Sri. G.V. Rajsekhar, HoD (I/c), Electrical Engineering department, Ongole campus	Member
8.	Mr. M. Rupas Kumar, Dean Academics, Ongole campus	Member

After welcoming the members, the chairperson noted that the quorum was present and called the meeting to order. The items discussed are taken up.

ITEMS FOR CONSIDERATION:

1. Considered item no.1: Finalizing the course syllabus for the third and final year of the B. Tech program as per AICTE.

Resolution:

Chairperson explained that the University has introduced B. Tech in Electrical and Electronics Engineering (EEE) at its constituent institutes located at Nuzvid (Krishna Dist.), RK Valley (Idupulapaya, Kadapa Dist.), Srikakulam (Etcherla, Srikakulam Dist.) and Ongole (Ongole Dist.). During the first BOS meeting dated. 29.12.2020 a tentative course structure for four year B.tech course was laid and the course syllabus for the first and second semesters has been approved. During the second BOS meeting dated. 22.09.2021 the course syllabus for the third and fourth semesters was approved. It has been tasked to prepare the course syllabus for the third and fourth years of the B. Tech Program as per the guidelines prescribed by AICTE.

The Members reviewed the approved draft course structure for the first, second, third, and fourth years of the B.Tech course.

After discussion, it is resolved to approve:

1) **Modifications in the fifth-semester courses as follows:**
    a. **Power Electronics:**
        i. **Add applications for DC-DC converters and fully integrated voltage regulators to Unit-VI.**
    b. **Power Electronics Lab:**
        i. **Replace all the experiments with the suggested experiments in order to eliminate outdated devices such as SCR. The modified list is as follows.**

1	**To study the characteristics of a Silicon Controlled Rectifier (SCR) and to find its holding and latching current**
2	**To study the switching characteristics of IGBT.**
3	**To study the switching characteristics of FET.**
4	**To study the full wave bridge rectifier circuit and understand**

its effects on power quality

5	**To study single phase inverters with different loading conditions.**
6	**To study three-phase inverter with different loading conditions**
7	**To study Sinusoidal Pulse Width Modulation**
8	**To study high frequency switching**
9	**To study the performance of DC-DC buck converter circuit at different duty ratios**
10	**To study the performance of single phase full bridge inverter circuit operating in square wave mode using IGBT**
11	**To study the performance of DC-DC boost converter circuit at different duty ratios**

c. Control Systems:

i. Include the Design of K_p, K_i, k_v parameters in Unit-III.

Modifications in the 4th-semester courses are as follows:

d. Power system operation and control:

i. Include Short term renewable energy scheduling problems in Unit-II.

ii. Include Introduction to HVDC & FACTS in Unit-VI.

e. Measurements and Instrumentation:

i. Include Microprocessor based meters, Multifunctional meters, and algorithms for energy estimation in Unit-II.

ii. Remove Dynamometer instruments from Unit-II.

iii. Include sampling frequency in Unit-VI.

f. High Voltage Engineering:

i. Remove High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, and safety precautions in H. V. Labs from unit – VI.

g. Electric Drives:

i. Remove Unit-VI and expand the contents of Unit-V to Unit-VI.

h. Advanced Control Systems:

i. Include Stability in Z-domain, Zury's test in Unit-III.

ii. Swap the positions of Unit-III and Unit-IV.

i. Wind and solar energy systems:

i. Change the title of the course to Renewable energy systems.

j. HVDC & FACTS:

i. Include elimination of harmonics by using converters in Unit-IV.

k. **Distribution System Planning and Automation:**
    i. **Include OLTC in Unit-III.**
    ii. **Include Radial systems, ring main systems, advantages, and disadvantages in Unit-IV.**
l. **Power System Protection:**
    i. **Include Phasor Measurement unit in Unit-VI.**
m. **Smart Electric Grid:**
    i. **Include Issues related to conventional grids in Unit-I.**
    ii. **Include smart meters in Unit II.**
n. **Fundamental of Electric and Hybrid Vehicles:**
    i. **Include converters for EV chargers in Unit-V.**

2. Considered item no.2: New curriculum for the upcoming engineering batch(2022-2026).

a. **Power Electronics (course+lab) and Electric vehicles (course+lab) should be swapped.**
b. **Electrical Machines:**
    i. **Unit-1 is swapped with unit-2 to maintain proper flow from the ET course.**
c. **Electrical Technology:**
    i. **"Two Wattmeter Method of Measurement of Three Phase Power" shifted to unit-4.**
    ii. **"Principles of electromechanical energy conversion and basic concepts of rotating machines", is introduced in unit-6.**
    iii. **Series resonance shifted from unit-4 to unit-3.**
d. **In E3-Semester-1, for SNO, Digital Signal Processing (DSP) should be introduced. It is recommended to offer Computer Networks, Digital System Design, Deep Learning, Computer organization & Architecture in electives.**
e. **Product & Innovation, Indian constitution are swapped.**
f. **All the courses which are having EC titles are offered here for EEE, if there is any change in those courses in ECE-BoS, those changes should be reflected in the EEE courses as well. If they offer in the same semester, the same code should be taken. If offered in different semesters, the code should be changed accordingly.**
g. **All the program elective courses(PEC) and Open elective courses(OEC) offered by the ECE department, can be offered as program elective and open elective courses to EEE students as well.**

Note: Any new relevant course can be added to the list of electives with the approval from the Board of Studies (BoS) from time-to-time.

3. Considered item no.3: Renaming the department of Electrical and Electronics Engineering(EEE) as **Electrical Engineering(EE)**.

At present, the department has its name Electrical & Electronics Engineering(EEE). It is suggested to rename the department as Electrical Engineering(EE) due to following reasons.

a. Most of the premier institutions in the country like IITs and NIT's have EE instead of EEE. Whereas most of the private institutions in the country are using the title EEE.
b. Having the name EE gives the major scope to diverge the field in various areas such as Computer science, AI, machine learning, IC design, Energy systems, VLSI, and signal processing.
c. Since the department is at its initial stage, and to achieve the vision of reaching world-class standards, it is suggested to follow some of the aspects of premier institutions like IIT's where Electrical Engineering is the major department.

Hence, The Board of Studies (BoS) unanimously agreed to renaming the department of Electrical and Electronics Engineering(EEE) as Electrical Engineering(EE) and the same shall be considered from the first batch (2018 batch) of the institute.

Rajiv Gandhi University of Knowledge Technologies

hodee EEE Nuzvid <hodee@rguktn.ac.in>

3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg

Dean, Academics - RGUKT, Nuzvid <dean.academics@rguktn.ac.in> Wed, Oct 12, 2022 at 2:19 PM
To: SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in>, ANESH J <ganeshjada@gmail.com>, kkrai <kkrai@chess.drdo.in>, HOD EEE Nuzvid <hodee@rguktn.ac.in>, RATNAKAR NUTENKI <ratnakar@rguktrkv.ac.in>, "shanthi@ee.iitm.ac.in" <shanthi@ee.iitm.ac.in>, "krishna@ee.iitm.ac.in" <krishna@ee.iitm.ac.in>, "krishna.vasudevan@iitm.ac.in" <krishna.vasudevan@iitm.ac.in>, "dvvrao@gmail.com" <dvvrao@gmail.com>, "hodeee@rguktsklm.ac.in" <hodeee@rguktsklm.ac.in>, Dean Academics IIIT-Ongole <da.ong@rgukt.in>, Dean Of Academics RKV <da@rguktrkv.ac.in>, Dean Academics IIIT-Srikakulam <da.sklm@rgukt.in>, "hodeee@rguktrkv.ac.in" <hodeee@rguktrkv.ac.in>, "hodeee@rguktong.ac.in" <hodeee@rguktong.ac.in>

It is fine from my side.

Get Outlook for Android

From: SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in>
Sent: Thursday, September 22, 2022 11:26:32 PM
To: ANESH J <ganeshjada@gmail.com>; kkrai <kkrai@chess.drdo.in>; HOD EEE Nuzvid <hodee@rguktn.ac.in>; RATNAKAR NUTENKI <ratnakar@rguktrkv.ac.in>; shanthi@ee.iitm.ac.in <shanthi@ee.iitm.ac.in>; krishna@ee.iitm.ac.in <krishna@ee.iitm.ac.in>; krishna.vasudevan@iitm.ac.in <krishna.vasudevan@iitm.ac.in>; dvvrao@gmail.com <dvvrao@gmail.com>; hodeee@rguktsklm.ac.in <hodeee@rguktsklm.ac.in>; Dean, Academics - RGUKT, Nuzvid <dean.academics@rguktn.ac.in>; Dean Academics IIIT-Ongole <da.ong@rgukt.in>; Dean Of Academics RKV <da@rguktrkv.ac.in>; Dean Academics IIIT-Srikakulam <da.sklm@rgukt.in>; hodeee@rguktrkv.ac.in <hodeee@rguktrkv.ac.in>; hodeee@rguktong.ac.in <hodeee@rguktong.ac.in>
Subject: 3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg

[Quoted text hidden]

3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg

hodee EEE Nuzvid <hodee@rguktn.ac.in> Mon, Oct 10, 2022 at 10:47 AM
To: SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in>
Cc: kkrai <kkrai@chess.drdo.in>, RATNAKAR NUTENKI <ratnakar@rguktrkv.ac.in>, shanthi@ee.iitm.ac.in, krishna.vasudevan@iitm.ac.in, hodeee@rguktsklm.ac.in, "Dean, Academics - RGUKT, Nuzvid" <dean.academics@rguktn.ac.in>, Dean Academics IIIT-Ongole <da.ong@rgukt.in>, Dean Of Academics RKV <da@rguktrkv.ac.in>, Dean Academics IIIT-Srikakulam <da.sklm@rgukt.in>, "hodeee@rguktrkv.ac.in" <hodeee@rguktrkv.ac.in>, "hodeee@rguktong.ac.in" <hodeee@rguktong.ac.in>

Dear Madam

It is fine from my side.

Regards
Chakravarthi
HOD-EEE
RGUKT-Nuzvid

[Quoted text hidden]

[Quoted text hidden]

Rajiv Gandhi University of Knowledge Technologies

hodee EEE Nuzvid <hodee@rguktn.ac.in>

3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg

RATNAKAR NUTENKI <ratnakar@rguktrkv.ac.in> Tue, Oct 4, 2022 at 5:29 PM
To: SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in>
Cc: kkrai <kkrai@chess.drdo.in>, HOD EEE Nuzvid <hodee@rguktn.ac.in>, shanthi@ee.iitm.ac.in, krishna.vasudevan@iitm.ac.in, hodeee@rguktsklm.ac.in, "Dean, Academics - RGUKT, Nuzvid" <dean.academics@rguktn.ac.in>, Dean Academics IIIT-Ongole <da.ong@rgukt.in>, Dean Of Academics RKV <da@rguktrkv.ac.in>, Dean Academics IIIT-Srikakulam <da.sklm@rgukt.in>, "Head of the Department, EE R K Valley, RGUKTAP" <hodeee@rguktrkv.ac.in>, hodeee@rguktong.ac.in

It's ok from my side.
Thanks & Regards
Ratnakar N
[Quoted text hidden]

Rajiv Gandhi University of Knowledge Technologies

hodee EEE Nuzvid <hodee@rguktn.ac.in>

3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg

SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in> Thu, Oct 27, 2022 at 10:14 AM
To: hodee EEE Nuzvid <hodee@rguktn.ac.in>

Mrs. Shravani P (M.Tech, NIT NAGPUR)
Assistant Professor,
EE Department,
IIIT NUZVID,
KRISHNA 521202.
+919502753557

---------- Forwarded message ---------
From: **HoD EEE** <hodeee@rguktsklm.ac.in>
Date: Thu, 27 Oct, 2022, 10:11 am
Subject: 3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg
To: <shravanivenugopal@rguktn.ac.in>
Cc: <hodee@rguktn.ac.in>

dear mam
it is fine with me

thanks and regards
Dr.GADDALA JAYARAJU
I/C HOD,EEE,RGUKT SKLM

Rajiv Gandhi University of Knowledge Technologies

hodee EEE Nuzvid <hodee@rguktn.ac.in>

3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg

N180665 SIRIPURAPU TANUJA <n180665@rguktn.ac.in> Thu, Oct 27, 2022 at 9:53 AM
To: hodee EEE Nuzvid <hodee@rguktn.ac.in>
Cc: SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in>

Dear sir , it is fine with me
[Quoted text hidden]

Rajiv Gandhi University of Knowledge Technologies

hodee EEE Nuzvid <hodee@rguktn.ac.in>

3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg

SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in> Thu, Oct 27, 2022 at 10:02 AM
To: hodee EEE Nuzvid <hodee@rguktn.ac.in>

Mrs. Shravani P (M.Tech, NIT NAGPUR)
Assistant Professor,
EE Department,
IIIT NUZVID,
KRISHNA 521202.
+919502753557

---------- Forwarded message ---------
From: **Shanthi Pavan** <shanthi@ee.iitm.ac.in>
Date: Sun, 25 Sep, 2022, 8:32 am
Subject: Re: 3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg
To: SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in>

Everything looks OK. PFA the filled form.

Rgds
Shanthi
[Quoted text hidden]
--
Shanthi Pavan
NT Alexander Institute Chair Professor
Department of Electrical Engg
Indian Institute of Technology, Madras
Chennai 600036
http://www.ee.iitm.ac.in/shanthi
Phone : +91-44-22574437
Fax : +91-44-22574402

Honorarium form.docx
44K

Rajiv Gandhi University of Knowledge Technologies

hodee EEE Nuzvid <hodee@rguktn.ac.in>

3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg

SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in> Thu, Oct 27, 2022 at 10:02 AM
To: hodee EEE Nuzvid <hodee@rguktn.ac.in>

Mrs. Shravani P (M.Tech, NIT NAGPUR)
Assistant Professor,
EE Department,
IIIT NUZVID,
KRISHNA 521202.
+919502753557

---------- Forwarded message ---------
From: **Dr. Krishna Vasudevan** <krishna@ee.iitm.ac.in>
Date: Thu, 6 Oct, 2022, 10:19 pm
Subject: Re: 3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg
To: SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in>

Dear Madam,

The modifications looks okay. Please change the name ‘Zury’s test’ to `Jury’s Test’ - a spelling error.

I am attaching the filled up honorarium form as well.

Regards,

Dr. Krishna Vasudevan
Professor, Dept of EE
IITM, Chennai, India

[Quoted text hidden]
[Quoted text hidden]
<Agenda of the meeting dated 17.09.2022.pdf><Draft course syllabus for List of electives-II.pdf>
<BEEE(Course and Lab)-Offered to other departments.pdf><Minutes of the meeting dated 17.09.2022.pdf>
<Updated Draft course syllabus for List of electives-I.pdf><Updated Draft Course Structure and Syllabus for upcoming batches (2022-2026).pdf><Updated Draft Course Syllabus of 3rd year B. Tech program.pdf>
<Honorarium form.docx>

nuzvid_kv_hon_form.pdf
189K

Rajiv Gandhi University of Knowledge Technologies

hodee EEE Nuzvid <hodee@rguktn.ac.in>

Fwd: BoS approval reg.

SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in> Thu, Oct 27, 2022 at 10:07 AM
To: hodee EEE Nuzvid <hodee@rguktn.ac.in>

Mrs. Shravani P (M.Tech, NIT NAGPUR)
Assistant Professor,
EE Department,
IIIT NUZVID,
KRISHNA 521202.
+919502753557

---------- Forwarded message ---------
From: **KRISHNA KUMAR RAI** <kkrai.chess@gov.in>
Date: Mon, 10 Oct, 2022, 4:30 pm
Subject: Re: BoS approval reg.
To: <shravanivenugopal@rguktn.ac.in>

Madam,

It is fine from my side.

PFA of honorarium form.

Regards
K.K.Rai
Sc 'F'
CHESS, DRDO

From: shravanivenugopal@rguktn.ac.in
To: "KRISHNA KUMAR RAI" <kkrai@chess.drdo.in>
Sent: Monday, October 10, 2022 2:46:27 PM
Subject: BoS approval reg.

Sir,
I am P.Shravani from RGUKT-NUZVID. As you know, I have mailed you the copy of draft BOS for the department of Electrical and Electronics RGUKT-NUZVID. I am waiting for your reply regarding the same. Kindly treat this as urgent as the semester has already started. Please do the needful at the earliest. Also, please attach honorarium form with the mail.

Mrs. Shravani P (M.Tech, NIT NAGPUR)
Assistant Professor,
EE Department,
IIIT NUZVID,
KRISHNA 521202.
+919502753557

honorarium format.PDF
355K

Rajiv Gandhi University of Knowledge Technologies

hodee EEE Nuzvid <hodee@rguktn.ac.in>

3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg

SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in> Thu, Oct 27, 2022 at 10:02 AM
To: hodee EEE Nuzvid <hodee@rguktn.ac.in>

Mrs. Shravani P (M.Tech, NIT NAGPUR)
Assistant Professor,
EE Department,
IIIT NUZVID,
KRISHNA 521202.
+919502753557

---------- Forwarded message ---------
From: **GANESH J** <ganeshjada@gmail.com>
Date: Fri, 23 Sep, 2022, 5:12 pm
Subject: Re: 3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg
To: SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in>

Dear Mam,

My comments are as follows:

1. In the minutes of the meeting (members joined through google meet), please change my details as follows:

Dr. J. Ganeswara Rao, Deputy Director, Central Electricity Authority, Ministry of Power, New Delhi

2. In point 3 of the minutes, the following may be added,

The Board of Studies (BoS) unanimously agreed to renaming the department of Electrical and Electronics Engineering(EEE) as Electrical Engineering(EE) and the same shall be considered from the first batch (2018 batch) of the institute.

3. In the list of electives, sl no. 1. Power system protection and switchgear, sl no. 10. Power system protection , I hope both are same and one may be deleted from the list. The following reference book may be included for Power system protection course:

Fundamentals of Power System Protection; PAITHANKAR, Y. G., Bhide, S. R. ; PHI Learning Pvt. Ltd., 2022

Filled Honorarium form is attached to the mail.

Regards

Dr. J. Ganeswara Rao

Deputy Director

Central Electricity Authority

Ministry of Power (GoI)

Sewa Bhawan, R K Puram, New Delhi-110022

9547891353

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2 attachments

Honorarium form Dr J G Rao.pdf
5059K

Honorarium form Dr J G Rao.docx
40K

Rajiv Gandhi University of Knowledge Technologies

hodee EEE Nuzvid <hodee@rguktn.ac.in>

3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg

vasanth veera <dvvrao@gmail.com> Tue, Sep 27, 2022 at 2:51 PM
To: SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in>
Cc: ANESH J <ganeshjada@gmail.com>, kkrai <kkrai@chess.drdo.in>, HOD EEE Nuzvid <hodee@rguktn.ac.in>, RATNAKAR NUTENKI <ratnakar@rguktrkv.ac.in>, shanthi@ee.iitm.ac.in, krishna@ee.iitm.ac.in, krishna.vasudevan@iitm.ac.in, hodeee@rguktsklm.ac.in, "Dean, Academics - RGUKT, Nuzvid" <dean.academics@rguktn.ac.in>, Dean Academics IIIT-Ongole <da.ong@rgukt.in>, Dean Of Academics RKV <da@rguktrkv.ac.in>, Dean Academics IIIT-Srikakulam <da.sklm@rgukt.in>, "hodeee@rguktrkv.ac.in" <hodeee@rguktrkv.ac.in>, "hodeee@rguktong.ac.in" <hodeee@rguktong.ac.in>

Dear Madam!

Thanks for the draft syllabus, no suggestions from me.

[Quoted text hidden]

Rajiv Gandhi University of Knowledge Technologies

hodee EEE Nuzvid <hodee@rguktn.ac.in>

3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg

Head of the Department, EEE R K Valley, RGUKTAP <hodeee@rguktrkv.ac.in> Thu, Oct 6, 2022 at 3:46 PM
To: SHRAVANI VISSAMSETTI <shravanivenugopal@rguktn.ac.in>
Cc: kkrai <kkrai@chess.drdo.in>, HOD EEE Nuzvid <hodee@rguktn.ac.in>, RATNAKAR NUTENKI <ratnakar@rguktrkv.ac.in>, shanthi@ee.iitm.ac.in, krishna.vasudevan@iitm.ac.in, hodeee@rguktsklm.ac.in, "Dean, Academics - RGUKT, Nuzvid" <dean.academics@rguktn.ac.in>, Dean Academics IIIT-Ongole <da.ong@rgukt.in>, Dean Of Academics RKV <da@rguktrkv.ac.in>, Dean Academics IIIT-Srikakulam <da.sklm@rgukt.in>, "hodeee@rguktong.ac.in" <hodeee@rguktong.ac.in>

It's ok from my side.

A.Sreekanth Reddy,
Head of The Department,
Electrical Engineering Department,
RGUKT, R K Valley

[Quoted text hidden]

Rajiv Gandhi University of Knowledge Technologies

hodee EEE Nuzvid <hodee@rguktn.ac.in>

3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg

HoD EEE <hodeee@rguktsklm.ac.in> Thu, Oct 27, 2022 at 10:17 AM
To: shravanivenugopal@rguktn.ac.in
Cc: hodee@rguktn.ac.in

dear mam
it is fine with me

thanks and regards
Dr.GADDALA JAYARAJU
I/C HOD,EEE,RGUKT SKLM

Rajiv Gandhi University of Knowledge Technologies

hodee EEE Nuzvid <hodee@rguktn.ac.in>

3rd Board of Studies Minutes of meeting, Modified Draft course syllabus for B.Tech course in EEE Reg

Dean Academics RGUKT-Ongole Campus <da@rguktong.ac.in> Thu, Oct 6, 2022 at 4:03 PM
To: "Head of the Department, EEE R K Valley, RGUKTAP" <hodeee@rguktrkv.ac.in>
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Everything looks good.

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RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNOLOGIES ANDHRA PRADESH

(NUZVID RKVALLEY SRIKAKULAM ONGOLE)

DEPARTMENT OF ELECTTICAL AND ELECTRONICS ENGINEERING

DRAFT COURSE STRUCTURE AND DETAILED SYLLABI FOR THE B.TECH PROGRAM IN ELECTRICAL AND ELECTRONICS ENGINEERING

(BOARD OF STUDIES PROPOSED COPY)

[AY 2022-23]

ENGINEERING FIRST YEAR : SEMESTER-1					
S. No	**Course Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**
1	BSC	MA1101	Engineering Mathematics-I	3-1-0	4
2	BSC	PY1104	Engineering Physics	3-1-0	4
3	BSC	PY1184	Engineering Physics Lab	0-0-3	1.5
4	ESC	EE1101	Fundamentals of Electrical Engineering	3-1-0	4
5	ESC	EE1102	Fundamentals of Electrical Engineering Lab	0-0-3	1.5
6	ESC	CS1109	Programming and Data Structures	3-1-0	4
7	ESC	CS1189	Programming and Data Structures Lab	0-0-3	1.5
8	HSS		Human Values	2-0-0	0
Total Credits				**14**	**20.5**
3 week Induction Programme (Non-Credit)- Before the Commencement of 1st Semester					

ENGINEERING FIRST YEAR : SEMESTER-2					
S. No	**Course Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**
1	BSC	EE1201	Electromagnetic Fields	3-0-0	3
2	BSC	MA1201	Engineering Mathematics-II	3-1-0	4
3	ESC	EC1201	Basic Electronics	3-1-0	4
4	ESC	EC1281	Basic Electronics Laboratory	0-0-3	1.5
5	PCC	EE1202	Electrical Macines-I	3-1-0	4
6	PCC	EE1203	Electrical Macines-I Laboratory	0-0-3	1.5
7	HSMC	EG1282	English Language Laboratory	1-0-3	2.5
8	ESC	CE1114	Engineering Graphics	1-0-2	2
9	MC	MC3101	Constitution of India	2-0-0	0
Total				**16**	**22.5**

ENGINEERING SECOND YEAR : SEMESTER-1					
S. No	**Course Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**
1	PCC	20EE2101	Network Analysis	3-1-0	4
2	PCC	20EE2102	Network Analysis Laboratory	0-0-3	1.5
3	PCC	20EC2101	Analog Electronic Circuits	3-1-0	4
4	PCC	20EC2181	Analog Electronic Circuits laboratory	0-0-3	1.5
5	BSC	20MA2101	Mathematics-III (Probability and Random processes)	3-1-0	4
6	PCC	20EE2103	Power Systems-I	3-1-0	4
7	ESC	20CS1209	Object Oriented Programming	3-1-0	4
8	MC		Professional Ethics	3-0-0	0
Total				29	23

ENGINEERING SECOND YEAR : SEMESTER-2					
S. No	**Course Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**
1	PCC	20EE2201	Electrical Machines-II	3-1-0	4
2	PCC	20EE2202	Electrical Machine-II Laboratory	0-0-3	1.5
3	PCC	20EE2203	Power Systems-II	3-1-0	4
4	PCC	20EC2203	Signals and Systems	3-1-0	4
5	PCC	20EC2205	Digital Logic Design	0-0-3	4
6	PCC	20EC2182	Digital Logic Design Lab	0-0-3	1.5
7	MC	BE4101	Environment Sciences	3-0-0	0
Total				28	19

ENGINEERING THIRD YEAR: SEMESTER-1

S. No	Course Category	Course Code	Course Title	L-T-P	Credits
1	PCC	20EC2103	Digital Signal Processing	4-0-0	4
2	PCC	20EC2203	Linear Integrated Circuits	3-1-0	4
3	PCC	20EC2283	Linear Integrated Circuits Lab	0-0-3	1.5
4	PCC	20EE3105	Internet of things Lab	0-0-3	1.5
5	PCC	20EE3101	Power Electronics	3-1-0	4
6	PCC	20EE3102	Power Electronics Lab	0-0-3	1.5
7	PCC	20EE3103	Control systems	3-1-0	4
8	PCC	20EE3104	Control systems Lab	0-0-3	1.5
9	PROJ	20EE3191	Mini-Project-I (Socially Relevant Project)	0-0-2	1.5
10	ESC	20HS3101	Aptitude and Reasoning	3-0-0	0
11	MC	HS31XX	Placement Skills	2-0-0	0
Total Credits					23.5

ENGINEERING THIRD YEAR: SEMESTER-2

S. No	Course Category	Course Code	Course Title	L-T-P	Credits
1	PCC	20EE3206	Power System Operation and Control(PSOC)	4-1-0	4
2	HSC	BMXY01	Product Design & Innovation	1-0-0	1
3	PEC	EE32XX	Elective-1	3-0-0	3
4	PEC	EE32XX	Elective-2	3-0-0	3
5	OEC	XX32XX	Open Elective-1	3-0-0	3
6	OEC	XX32XX	Open Elective-2	3-0-0	3
7	PROJ	20EE3292	Mini Project-II	0-0-3	1.5
8	PROJ	20EE3210	Summer Internship (After VI semester)		3
Total Credits					**21.5**
MC		20MC3201	Career Development Course	2-0-0	0

Total contact hours : 18 hours
*Mini Project-2 work load not included in above calculation

ENGINEERING FOURTH YEAR: SEMESTER-1					
S. No	**Course Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**
1	PEC	20EC41XX	Elective-3	3-0-0	3
2	PEC	20EC41XX	Elective-4	3-0-0	3
3	OEC	20XX41XX	Open Elective-3	3-0-0	3
4	PROJ	20EC4192	Summer Internship Project	0-0-6	3
5	PROJ	20EC4193	Project I	0-0-8	4
Total Credits					**16**

Total contact hours: 11 hours

*Project-1 work load not included in above calculation

*Summer Internship Project will be after completion of Engineering Third Year Semester-2

ENGINEERING FOURTH YEAR: SEMESTER -2					
S. No	**Course Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**
1	HSC	20HS4299	Community Service	0-0-4	2
3	PEC	20EC42XX	Elective-5	3-0-0	3
5	OEC	20XX42XX	Open Elective-4	3-0-0	3
6	PROJ	20EC4294	Project-II & Dissertation	0-0-12	6
Total Credits					**14**

Total contact hours: 6 hours

*Project-2 and Community Service work load not included in above calculation

	TOTAL	E1-S1	E1-S2	E2-S1	E2-S2	E3-S1	E3-S2	E4-S1	E4-S2
BSC	**20.5**	9.5	7	4	0	0	0	0	0
ESC	**22.5**	11	7.5	4	0	0	0	0	0
HSC	**5.5**	0	2.5	0	0	0	1	0	2
PCC	**66**	0	5.5	15	19	22	4	0	0
PEC	**15**	0	0	0	0	0	6	6	3
OEC	**12**	0	0	0	0	0	6	3	3
PROJECTS/ MINI PROJ	**13**	0	0	0	0	1.5	1.5	4	6
SUM INTERN	**6**	0	0	0	0	0	3	3	0
	160	**20.5**	**22.5**	**23**	**19**	**23.5**	**21.5**	**16**	**14**

20EC2103	Digital Signal Processing	PCC	4L: 0T: 0P	4 credits

Course Objective

1. To understand the mathematical approach to manipulate discrete time signals, which are useful to learn digital systems.
2. To study the transformations on digital signals.
3. To understand the concepts of digital filters.

Course Content

Unit-I Introduction (10 hours)

A basic review of Signals and Systems, Basic elements of digital signal processing, Time domain representation of discrete time signals, Basic Operations on sequences including Sampling rate alteration, Classification of sequences. Discrete time systems, Time domain characterization of LTI DTS: Convolution sum, Impulse & Step Responses, Simple Interconnection schemes, Linear Constant Coefficient Difference Equations (of Finite- dimensional LTI DTS), Classification of LTI DTS: FIR & IIR, Recursive, & Non- recursive.

Unit-II Discrete Time Fourier Transform (DTFT) (10 hours)

Introduction, Fourier Transform Representation of aperiodic Discrete-Time Signals, Periodicity-convergence of DTFT, Properties of DTFT, Signal Transmission Through LTI Systems, Ideal and Practical Filters, energy spectral Density, Power spectral Density.

Unit-III Discrete Fourier Transform (DFT) (12 hours)

Sampling of DTFT, Discrete Fourier Transform(DFT) and its Inverse, DFT as a Linear Transformation, Properties of DFT, Linear Convolution Using the DFT, Filtering of Long Data Sequences Using DFT, Spectrum analysis Using DFT.

Fast Fourier Transform (FFT)

Introduction ,Computational Complexity of the Direct Computation of the DFT , Decimation- In-Time (DIT) FFT Algorithm, Decimation-in-Frequency (DIF) FFT Algorithm and their comparison, Inverse DFT using FFT Algorithm, A Linear Filtering approach to Computation of the DFT-The Goertzel Algorithm ,The Chirp-z Transform Algorithm.

Unit IV: Z transforms (10hours)

Introduction ,Bilateral (Two-sided) Z-transform , Relationship Between Z-transform and DTFT,Z-Plane, Region-of-Convergence for Z-transforms and their properties, properties of Z-transform, Z-Transform of Causal Periodic Signals, Inversion of the Z-transform, Analysis and Characterization of LTI Systems using the Z-transform. Unilateral (One-Sided) Z-transform, Properties of unilateral Z-Transform. Transient response and steady-State response, Block Diagrams Representation. Applications of Z- Transform in Signal Processing.

Unit-V: Filter Concepts (10 hours)

Introduction, Frequency Response and Filter Characteristics, Zero-Phase Filter, Linear phase Filter, simple FIR and IIR Digital Filter, All pass Filters, Minimum-Phase, Maximum-Phase and

Non-minimum (Mixed) Phase Systems, averaging filter, comb filter, Notch filter.

Unit-VI: Realization of Digital Filters (10 hours)

Introduction, FIR Filter, IIR Filter, Non-recursive and Recursive Structures, FIR Filter Structures, Basic Structures for IIR Systems , Lattice Structures for FIR and IIR systems.

Learning Resources

Text Books

1. A.V. Oppenheim and R.W. Schaffer, '*Discrete Time Signal Processing'*, 3rd edition, Pearson Education/PHI,2014.
2. John G. Proakis, Dimitris G.Manolakis, '*Digital Signal Processing, Principles, Algorithms, and Applications*', 4th edition, Pearson Education / PHI, 2007.

Reference Books

1. B. P. Lathi, Roger Green, '*Essential of Digital Signal Processing', Cambridge University Press, 2014.*
2. Sanjit K Mitra, *'Digital signal processing: A computer base approach',* 4th edition, Tata McGraw Hill, 2013.
3.

Web Resources

1. Prof Alan V. Oppenheim, OCW- Massachusetts Institute of Technology(MIT), '*Digital Signal Processing'*
URL:https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring- 2011/index.html
2. Prof S C Dutta Roy, NPTEL-IIT-Delhi, *Digital Signal Processing*
URL:http://nptel.ac.in/courses/117102060/
3. Prof T K Basu, NPTEL, IIT-Kharagpur, *Digital Signal Processing*
URL:http://nptel.ac.in/courses/108105055/

Course Outcomes:

After the completion of the course, the students will be able to

CO1	Interpret ,represent and process discrete/digital signals and systems
CO2	Understand the spectral analysis of signals
CO3	Design &analyze DSP systems like FIR and IIR Filter etc
CO4	Familiarize with multirate signal processing
CO5	Familiarize with applications of Digital Signal Processing

20EC2203	Linear Integrated Circuits	PCC	3L: 1T: 0P	4 credits

Course Learning Objectives

1. To study the basic principles, configurations and practical limitations of an op-amp.
2. To understand the various linear and non-linear applications of op-amp
3. To analyze and design op-amp oscillators, single chip oscillators and frequency generators
4. To understand the operation of the most commonly used D/A and A/D converter types and its applications

Course content

Unit-I: Feedback Amplifiers **(10hours)**

Feedback concept, General characteristics of Negative feedback amplifier, Different feedback amplifiers (Voltage-series feedback, Current-series feedback, Current-shunt feedback, Voltage-shunt feedback), Effect of negative feedback on input and output impedances, gain & bandwidth.

Unit-II: Operational Amplifiers **(10hours)**

Ideal op-amp parameters, non-ideal op-amp, op-amp in negative feedback, bandwidth and slew rate on circuit performance. Op-amp applications - summing amplifier, integrator, differentiator, Instrumentation amplifier, V to I and I to V converter, comparator, precision Rectifier, log and antilog amplifier. Active filters.

Unit-III: Wave shaping circuits & Oscillators **(12hours)**

Positive feedback concept, Barkhausen criterion and design of RC phase oscillators, Wien Bridge oscillator. Ring oscillator, LC oscillators and crystal oscillators, Multivibrators Astable, Monostable and Bistable Multivibrators, Schmitt trigger, square generators.

Unit-IV: DC-DC Converters **(8hours)**

Introduction, Performance parameters of DC-DC converters, Frequency limiting parameters, Types of converters: Buck, boost and buck-boost.

Unit-V: PLL **(10hours)**

Basic PLL topology and principle, Major building blocks of PLL- analog and digital phase detector, VCO, applications of PLL.

Unit-VI: Data Converters **(10hours)**

Analog vs. discrete time signals, Sample-and-Hold circuits, ADC architectures (Flash ADC, Successive Approximation ADC, Dual slope ADC. DACs (Binary weighted resistors, R-2R DAC and current steering DAC). INL &DNL

Learning Resources

Textbooks

1. Behzad Razavi, '*Fundamentals of Microelectronics*', Wiley Publications
2. Sedra and Smith, *'Microelectronics Circuits'*, Oxford Publications, 6th Edition.
3. Jacob R Baker, *'CMOS Mixed Signal Circuit Design'* Wiley Publications.

Reference Books

1. Boylestad R. L. and L. Nashelsky, *'Electronic Devices and Circuit Theory'*, 11th edition, Pearson, 2009.
2. Millman J. and C. Halkias, *'Integrated Electronics'*, 2nd edition, TMH, 2010.
3. Neamen D., *'Electronic Circuit Analysis and Design'*, 3rd edition, TMH, 2006
4. Spencer R. R. and M. S. Ghausi, *'Introduction to Electronic Circuit Design'*, Pearson, 2003

Web Resources

1. Prof D Nagendra Krishnapura, NPTEL-IIT Madras, *'Analog Integrated Circuit Design'* URL:https://nptel.ac.in/courses/117106030/
2. Prof K Radhakrishna Rao, NPTEL-IIT Madras, *'Electronics for Analog Processing-II'*, URL:https://nptel.ac.in/courses/117106088/

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

CO1	Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
CO2	Elucidate and design the linear and nonlinear applications of an op-amp and special application ICs.
CO3	Explain and compare the working of multi vibrators using special application IC 555 and general purpose op-amp.
CO4	Classify and comprehend the working principle of data converters.
CO5	Illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication.

20EC2283	Linear Integrated Circuits Laboratory	PCC	0L: 0T: 3P	1.5 credits

Course Learning Objective

1.Experimentally demonstrate the frequency response of amplifiers
2.Practical knowledge on different types of multivibrators and their applications
3.Introductory designs on Analog to Digital Converters
4.Practical exposure to CMOS circuit design especially operational amplifiers
5.Familiarization with CAD tool for analog circuit design

List of Experiments

1. Design and analysis of Feedback amplifiers.
2. Frequency response of inverting & non-inverting amplifier.
3. Design of an Instrumentation amplifier.
4. Schmitt trigger & Noise suppression using Bistable multivibrator.
5. Monostable & Astable multivibrator using opamp.
6. Design of amplifier using CMOS inverters.
7. Two-bit flash ADC design.
8. Design of a typical CMOS inverter (sizing) using EDA tool and finding transfer characteristics & finding the propagation delay.
9. Design of a two input CMOS NAND & NOR gates (sizing) using EDA tool.
10. Design of a fully differential single stage opamp using resistive loads using EDA tool
11. Design of a single stage opamp using diode connected load using EDA tool
12. Term Project (Designing Public Addressing System).

***EDA tool may be Mentor Graphics/Synopsys/Cadence tools**

Note: It is mandatory to perform experiments (1-7) on LT spice tool before the experiment is done on hardware. All experiments must be unique, design specifications should not be common in the lab.

Course outcome:

After the completion of this Laboratory course, the student will be able to

CO 1	To analyze the frequency response of amplifiers
CO 2	Experimentally know the noise suppression in bistable multivibrators
CO 3	Utilization of IC 555 timer
CO 5	Design of Analog to Digital Converters
CO 6	Design of CMOS circuits using CAD tool

20EE3101	Power Electronics	PCC	3L: 1T: 0P	4 credits

Course Learning Objectives:

1.To introduce the concept of semiconductors devices for high power supply and their applications.
2.To understand the need for Power Electronics Devices and Circuits and their basic operation.

Course content

Unit-I: Introduction (10 hours)
Introduction to Power Electronics, Power Semi-Conductor Devices: Power Diodes, power Transistors, power MOSFETs, IGBTs, GTOs, Thyristors, Basic theory of operation, characteristics, Ratings, Protection and cooling, line commutation and forced commutation circuits.

Unit II: Converters (10 hours)
Power Electronic converters: 1-phase / 3 phase rectifier circuits, 1-phase / 3 phase phase-controlled converters (Semi-converters, full–converters and Dual converters) using IGBT. Analysis and performance with passive and active load, Harmonics and power factor, Introduction to power quality.

Unit III: D.C converters (6 hours)
D.C-to-D.C converters (choppers): Buck, Boost and Buck-Boost type and various chopper configurations.

Unit IV: A.C converters (8 hours)
A.C-to-A.C converters: A.C voltage controllers, Cyclo-converters, Introduction to matrix converters

Unit V: Inverters (10 hours)
D.C–to-A.C converters (Inverters): 1-phase VSI in half bridge and full bridge configuration, CSI, Frequency and voltage control, Line-commutated inverters (LCIs).

Unit-VI: APPLICATIONS (8 hours)
Power system applications- Static AC circuit breaker, interconnection of renewable energy sources and energy storage systems to the utility, Industrial applications -Switch mode welder, Voltage source series resonant inverters in induction heating, solid state relay. Applicatons for DC-DC converters, fully integrated voltage regulators.

Learning Resources

Text Books

1. Daniel W Hart, *Power Electronics* Tata Mc Graw Hill

2. Issah Batterseh, *Power Electronic Circuits*, Wiley.

3. N. Mohan, T.M. Undeland& W.P. Robbins, *Power Electronics: Converter, Applications & Design*, John Wiley & Sons, 1989

4. Muhammad H. Rashid, *Power Electronics: Circuits, Devices, and Applications*, Pearson, 2009

Reference Books

2. Bimal K Bose, *Modern Power Electronics and AC motor Drives*, Pearson Publishers.

3. Joe H. Chow, Alex M. Stankovic, David J. Hill, *Power Electronics and Power Systems* Springer Publications.

Web Resources:

1. Prof. G. Bhuvaneshwari, NPTEL-IIT-Delhi, Power Electronics.
URL:https://archive.nptel.ac.in/courses/108/102/108102145/

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

CO1	Understand the need for Power Electronics Devices and Circuits and their basic operation.
CO2	Perform an analysis of driving and control and triggering circuits for Power Electronic converters
CO3	Perform an analysis of AC to DC converters (Single phase and three phase, controlled and uncontrolled), A.C Voltage controllers, DC to DC converters(choppers), and single phase D.C to A.C converters (Inverters) in square wave mode.
CO4	Perform Fourier analysis and knowledge of Power Quality issues associated with power electronic circuits.
CO5	Understand different applications of power electronics.

20EE3102	**Power Electronics Lab**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective:

The course is introduced to the students to enable laboratory scale practical knowledge about power system operation and performance analysis of both hardware and software.

List of Experiments:

1. To study the characteristics of Silicon Controlled Rectifier (SCR) and to find its holding and latching current
2. To study the switching characteristics of IGBT.
3. To study the switching characteristics of FET.
4. To study the full wave bridge rectifier circuit and understand its effects on power quality
5. To study single phase inverter with different loading conditions.
6. To study three phase inverter with different loading conditions
7. To study Sinusoidal Pulse Width Modulation
8. To study high frequency switching
9. To study the performance of DC-DC buck converter circuit at different duty ratios
10. To study the performance of single phase full bridge inverter circuit operating in square wave mode using IGBT
11. To study the performance of DC-DC boost converter circuit at different duty ratios
12. Generation of PWM pulses using micro controller kit.
13. Study of an inverter fed adjustable speed drive for a 3- phase induction motor.
14. Single phase and Three phase uncontrolled rectifier with Smoothing Capacitor

Course Outcomes: Upon successful completion of the course, student should be able to

CO1	Understand the basic concepts of device characteristics and triggering techniques
CO2	Understand the operation of different type of rectifier/converter circuits with different loads
CO3	Understand the operation of choppers, AC voltage controllers and inverters

20EE3103	**Control Systems**	**PCC**	**4L: 0T: 0P**	**4**

Course Learning Objective

1. To explore the modeling of linear dynamic systems via differential equations and transfer functions utilizing state- pace and input-output representations.
2. Analysis of control systems in the time and frequency domains and using transfer function and state-space methods.
3. Study of the classical stability tests, such as the Routh-Hurwitz and Nyquist criterions, and design methods using root-locus plots and Bode plots.

Course content

Unit-I: Introduction (6 hours)

Introduction-Open loop and closed loop control systems- Transfer functions- Block diagrams and their reduction-Signal flow graphs-formula.

Unit-II: Mathematical modeling (6 hours)

Mathematical modeling and transfer functions of electrical circuits and mechanical systems. Principle and operation of Servo motors and Stepper motors.

Unit-III: Time response analysis (10 hours)

Standard test signals, step response of first and second order systems Time response specifications steady state error static error and generalized error coefficients response with proportional, derivative and integral controllers. Design of K_p, K_i, k_v parameters.

Unit-IV: Stability analysis (6 hours)

Stability concept, characteristic equation, location of roots in the s-plane for stability Routh-Hurwitz criterion, Root locus rules for the construction of root locus- construction of root locus using MATLAB/SIMULINK.

Unit-V: Stability analysis cntd. (8 hours)

Introduction-Bode Plots Gain margin and Phase margin - Polar plots - Nyquist stability criterion Need for compensators. Introduction to Lag and lead compensators in frequency domain.

Unit-VI State space Analysis (10 hours)

Concepts of state, state variables and state model, derivation of State models from block diagrams, Diagonalization, Solving the Time invariant state Equation, state transition Matrix and its Properties Concepts of Controllability and Observability.

Learning Resources

Text Books:

1. B.C. Kuo, *Automatic control systems*, John Wiley and Sons, 8th edition, 2003.
2. K. Ogata, *Modern control systems*, Prentice Hall of India Pvt. Ltd., 5th edition, 2010.

References

1. I. J. Nagrath and M. Gopal, *Control System Engineering*, New Age International (P) Limited Publishers, 5th edition,2007.
2. Norman S. Nise, *Control System Engineering*, Wiley India, 5th edition2000.

Web Resources:

1. Prof. C.S. Shankar Ram, NPTEL, IIT-Madras, Control Systems.
   URL: https://archive.nptel.ac.in/courses/107/106/107106081/

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

CO 1	Analyze controllability and observability of linear systems.
CO 2	Design state-space controller and appropriate (deterministic) observer.
CO 3	Design controller with frequency design methods.
CO 4	Apply root-locus method for analysis and synthesis.
CO 5	Apply pole placement controller design approach.
CO 6	Design linear quadratic regulator for discrete-time systems.

20EE3104	Control Systems Lab	PCC	0L: 0T: 3P	1.5 credits

Course learning objective:
The objective of the lab is to design a system and calculate the transfer function, analyzing the stability of the system (both open and closed loop, with positive and negative feedback) with time domain approach and frequency response analysis, using MATLAB and also developing the system which is dynamic in nature with state space analysis approach.

List of Experiments:

1. Time response of Second Order systems using MATLAB
2. Characteristics of Synchros
3. Programmable Logic Controller-Study and verification of truth tables of logic gates, simple Boolean expressions and application of speed control of motor
4. Effect of feedback on DC servo motor
5. Transfer function of DC motor
6. Effect of P, PD, PI, PID Controller on second order systems.
7. Lag and Lead compensation - Magnitude and phase plot
8. Position control of DC motor.
9. Temperature controller using PID
10. Characteristics of AC Servo motor.
11. PSPICE simulation of of P, PD, PI, PID Controller using Op-Amp for second order systems
12. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system using MATLAB.
13. State space model for classical transfer function using MATLAB

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

CO1	Recognize the symbols for the different parts of a block diagram: functional blocks, summing blocks and branch points
CO2	Model a mechanical (masses, dampers and springs) and electrical system (inductors, resistors, capacitors) in the form of a transfer function
CO3	Determine the impulse, step, and ramp response of a system, given a transfer function model
CO4	Perform Routh's stability criterion and root locus of a system to determine

	stability
CO5	For systems with unknown values, determine the range of values for which the system will be stable and explain how adding a pole or a zero affects the stability
CO6	Analyze feedback control systems in the time and frequency domain to use state space concepts to describe systems
CO7	Recognize the "type" of a system (based on the number of free integrators) and discuss the expected error characteristics as related to step, ramp, and acceleration inputs
CO8	Interpret design criteria as related to the closed loop pole location on the complex plane
CO9	Draw the Frequency response plots like Bode, Nyquist and Polar plots (magnitude and phase) for a given transfer function
CO10	Design feedback compensators to achieve a set of desired closed loop system characteristics and design a compensator in the frequency domain to meet specific design requirements using a lead compensator, lag compensator, or lead-lag compensator

20EE3105	Internet of Things Lab	ESC	0L: 0T: 3P	1.5 Credits

Course Learning Objectives

1. To assess the vision and introduction of IoT.
2. To understand IoT Market perspective.
3. To implement Data and Knowledge Management and use of Devices in IoT Technology
4. To indulge in designing of prototype hardware for different IoT application.

Exercise-I

Introduction & Overview of Internet of things

The Internet of things today and tomorrow, IoT architecture outline , Functional blocks of IOT , industrial IOT, IOT enabled Smart devices in market, Application areas for IOT, Challenges in IOT. Hardware and Software tools required for IOT application development.

Exercise - II

Exploring the arduino board and its software IDE

The Arduino board, The command area, text area and message window area. Setup function, Controlling the hardware, loop functionality, verifying your sketch, uploading and running your sketch and finally modifying your sketch according to your requirement.

Exercise - III

Introduction to sensors and displays

Interfacing sensors to Arduino boards about the sensor, the circuit connections, sketch (software program), Application.And interfacing displays to arduino board

Exercise - IV Communication

Wireless communication, introduction to Bluetooth module, interfacing to Arduino in both one way communication and two way communication, controlling an LED in wireless mode, interfacing wifi module with arduino controlling things by using local network.

Exercise - V

Introduction to NodeMCU (ESP32 Wi-Fi SoC)

Controlling the things with NodeMCU using wifi communication in both ways and interfacing nodemcu with various peripheral devices. Compare Esp8266 with other arduino boards

Exercise-VI

Introduction to Cloud platforms

IOT device to cloud storage communication Model, need of Cloud services in IOT, different Cloud storage services available today, Cloud Data processing and frame format, Role of Smart phones in IOT, Examples on Home automation and Smart city development, Introduction to clouds like Temboo, Blynk, Pubnub etc.

Exercise -VII

Introduction to GSM, GPS Module

Interfacing Arduino (uno) with GSM, Module 2G communication and interfacing GPS module for tracking location. Interfacing camera module.

Exercise -VIII

Interfacing to External devices

Interfacing Arduino with External storage, Ex: SD card (reading, writing) Handling Interrupts and memory management and Ethernet communication.

Exercise-IX

Introduction to Raspberry pi

Features, Comparison with Arduino, Hardware details and Programming.

Exercise-X

App Inventor

Create apps with coding, Designing apps and interfacing with Arduino.

Exercise-XI

Any one of the project from the list below

Project -I

1.Home Automation with blue tooth and WIFI and controlling the things with Mobile Apps

2.Designing water level controller.

Project -II

1.Designing women safety system with GPS and GSM module

2.Designing secured car parking system using GPS and GSM module

Project -III

1.Uploading sensor information to cloud, operating and Monitoring

2.Designing Smart Hospital with IoT devices.

Web resources:

1. Prof Sudip Misra, NPTEL-IIT Kharagpur, Intorducton to Internet of Things,

   URL: https://nptel.ac.in/courses/106105166/

Course outcomes: At the end of the course, the student will

CO1	Understand and analyze concepts of Internet of Things
CO2	Familiar with arduino board and its software
CO3	Interfacing sensors with arduino board and its working
CO4	Analyze basic protocols in wireless sensor network
CO5	Understand Node MCU arduino board for global communication
CO6	Understand cloud platform to operate our devices through controller
CO7	Design IoT applications in different domain and be able to analyze their Performance

20EE3201	Power system operation and control	PCC	4L:0T:0P	4 Credits

Course objectives:

1. To understand optimal dispatch of generation with and without losses.
2. To study the optimal scheduling of hydro thermal systems.
3. To study the optimal unit commitment problem.
4. To understand the reactive power control and compensation of transmission lines.

Course contents:

Unit-I: Economic Operation of Power Systems (10 hours)

Optimal operation of Generators in Thermal Power Stations, - heat rate Curve – Cost Curve – Incremental fuel and Production costs, input-output characteristics, Optimum generation allocation with line losses neglected. Optimum generation allocation including the effect of transmission line losses – Loss Coefficients, General transmission line loss formula.

Unit-II: Hydrothermal Scheduling (10 hours)

Optimal scheduling of Hydrothermal System: Hydroelectric power plant models, scheduling problems-Short term hydrothermal scheduling problem, Short term renewable energy scheduling problem.

Unit-III: Modeling (10 hours)

Modeling of Turbine: First order Turbine model, Block Diagram representation of Steam Turbines and Approximate Linear Models. Modeling of Governor: Mathematical Modeling of Speed Governing System – Derivation of small signal transfer function. Modeling of Excitation System: Fundamental Characteristics of an Excitation system, Transfer function, Block Diagram Representation of IEEE Type-1 Model.

Unit-IV: Single Area & Two-Area Load Frequency Control (10 hours)

Necessity of keeping frequency constant. Definitions of Control area – Single area control – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case

Unit-V: Reactive Power Control (10 hours)

Overview of Reactive Power control – Reactive Power compensation in transmission systems – advantages and disadvantages of different types of compensating equipment for transmission systems. `

Unit-VI: Load compensation **(10 hours)**

Specifications of load compensator, Uncompensated and compensated transmission lines: shunt and Series Compensation. (Qualitative treatment). Introduction to HVDC & FACTS.

Text books:

1. Dr. K. Uma Rao, *Power System Operation and Control*, Wiley India Pvt. Ltd.

2. Grainger and Stevenson, *Power System Analysis*, Tata McGraw Hill.

Reference books:

1. P S R Murthy, *Operation and Control in Power Systems*, BS Publications.

2. Prabha Kundur, *Power systems stability and control*, The McGraw Hill.

3. C.L.Wadhwa, *Power System Analysis*, New age International.

4. I.J.Nagrath & D.P.Kothari, *Modern Power System Analysis*, Tata McGraw Hill Publishing Company Ltd.

5. J.Duncan Glover and M.S.Sarma, *Power System Analysis and Design*, Cengage Learning.

Course Outcomes: After the completion of course the student will be able to,

CO1	Compute optimal scheduling of Generators.
CO2	Understand hydrothermal scheduling.
CO3	Understand importance of PID controllers in single area and two area systems.
CO4	understand reactive power control and compensation for transmission line.
CO5	understand importance of PID controllers in single area systems.

RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNOLOGY
ANDHRA PRADESH

(NUZVID RK VALLEY SRIKAKULAM ONGOLE CAMPUSES)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

DRAFT COURSE STRUCTURE AND DETAILED SYLLABI FOR THE B.TECH PROGRAM IN ELECTRICAL & ELECTRONICS ENGINEERING

(BOARD OF STUDIES PROPOSED COPY)

[AY 2022-23]

Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electrical & Electronics Engineering

CONTENTS

		Mandatory Courses	
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		22BE4101:Environmental Studies	
		22MC3101:Career Development Course	
	(iv)	**Program Core Courses**	
		22EC2102:Digital Logic Design	
		22EC2182:Digital Logic Design Laboratory	
		22EE1201: Network Theory	
		22EC21XX:Signals and Systems	
		22EC2101:Analog Electronic Circuits	
		22EC2181:Analog Electronic Circuits Laboratory	
		22EE2101:Electrical Machines	
		22EE2181:Electrical Machines Lab	
		22EE2201: Power Systems-I	
		22EE2204: Machine Learning	
		22EE2202:Control Systems	
		22EE2282:Control Systems Lab	
		22EC2203:Linear Integrated Circuits	
		22EC2283:Linear Integrated Circuits Laboratory	
		22EC31XX: Digital Signal Processing	
		22EE3101: Power Systems-II	
		22EE3181: Power Systems Lab	
		22EE2203: Power Electronics	
		22EE2283: Power Electronics Lab	
		22EE3102: Introduction to Electrical Vehicles	
		22EE3182: Electrical Vehicles Lab	
		22EC31XX: Embedded Systems	
		22EC31XX: Embedded Systems lab	
	(v)	**Program Elective Courses (The list will be updated after finalizing the electives)**	
		22EEXXXX: Electrical Distribution System	
		22EEXXXX: Smart Grid Technology	
		22EEXXXX:Power System Protection	
		22EEXXXX: Power System Operation & Control	
		22EEXXXX: Non Conventional energy Sourses	
		22EEXXXX: EV Batteries & Battery Management System	
		22EEXXXX: Fundamental of Electric and Hybrid Vehicles	
		22EEXXXX: Switched Mode Power Conversion	
		22EEXXXX: Electric Drives	
		22EEXXXX: HVdc Transmission Systems	
		22EEXXXX: High Voltage Engineering	

		22EEXXXX: Industrial Electrical Systems	
		22EEXXXX: Digital Control Systems	
		22EEXXXX: Digital Signal Processing	
		22EEXXXX: Control Systems Design	
		22EEXXXX: Computer Organization and Architecture	
		22EEXXXX: Advanced Digital Signal Processing	
		22EEXXXX: Artificial Neural Networks	
		22EEXXXX: Bio Medical Signal Processing	
		22EEXXXX: Digital Image Processing	
		22EEXXXX: Estimation of Signals and Systems	
		22EEXXXX: Medical Image analysis	
		22EEXXXX: Pattern Recognition and Applications	
		22EEXXXX: Analog IC Design	
		22EEXXXX: Digital IC Design	
		22EEXXXX: Digital VLSI System Design	
		22EEXXXX: Electronics Systems Packaging	
		22EEXXXX: Embedded System Software Testing	
		22EEXXXX: FPGA based System design	
		22EEXXXX: Low Power Circuits and Systems	
		22EEXXXX: MEMS and Microsystems	
		22EEXXXX: System Verilog	
		22EEXXXX: VLSI DSP	
		22EEXXXX: VLSI Physical Design	
		22EEXXXX: VLSI Testing and Verification	
	(vi)	**Open Elective Courses**	
		22EEXXXX: Artificial Intelligence	
		22EEXXXX: Computational Science and Engineering using Python	
		22EEXXXX: Linux programming and Scripting	
		22EEXXXX: Robotics Operating System: Drones	
	(vii)	**Seminars/Mini Projects/Projects**	
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		22EEXXXX:Project-I	
		22EEXXXX:Project-II & Dissertation	
		22XXXXXX:Product Design & Innovation	
	(viii)	**Courses being offered to other Departments**	
		22EEXXXX: Electrical Technology	
		22EEXXXX: Electrical Technology Laboratory	

		22EEXXXX: Basic Electrical & Electronics Engineering	
		22EEXXXX: Basic Electrical & Electronics Engineering lab	

Chapter-1

General, Course structure, Semester-wise credit distribution

A. **Definition of Credit:**

1 Hour Lecture (L) per week	1 credit
1 Hour Tutorial (T) per week	1 credit
3 Hours Practical (Lab)/week	1.5 credits

B. Total number of credits: 160

C. Minimum number of contact hours/weeks per semester: 15 weeks of teaching

For 1 credit course: 15 contact hours per semester
For 2 credit course: 30 contact hours per semester
For 3 credit course: 45 contact hours per semester
For 4 credit course: 60 contact hours per semester

D. Course code and definition, Abbreviations

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
EC	Core Courses
ECEL	Program Electives
ECP1	Project Stage-I
ECP2	Project Stage-II
ECMP1	Mini Project Stage-I
ECMP2	Mini Project Stage-II
ECSI	Summer Internship
BS	Basic Science
ES	General Engineering Courses
HS	Humanities and Social Sciences including Management Science
OE	Open Electives
MC	Mandatory Courses
PCC	Program Core Course
PEC	Program Elective Course
OEC	Open Elective Course
BSC	Basic Science Course
HSC	Humanities and Social Sciences including Management Science Course
PROJ	Mini project/Project

E.Structure of Program

S.No	Category	Credits
1	Basic Science Courses	20
2	Engineering Science Courses	24
3	Humanities and Social Sciences including Management courses	8.5
4	Program core courses	65.5
5	Program Elective courses	15
6	Open Elective courses	12
7	Project work, Miniproject work, Summer internships project	15
8	Mandatorycourses - 03 [Indian Constitution, Environmental Studies, Career Development Course]	(non- credit)
	Total	160

F. Semester-wise Credits Distribution

	TOTAL	E1-S1	E1-S2	E2-S1	E2-S2	E3-S1	E3-S2	E4-S1	E4-S2
BSC	20	10.5	6.5	3	0	0	0	0	0
ESC	24	12.5	5.5	5	1	0	0	0	0
HSC	8.5	0	2.5	0	0	2.5	1.5	0	2
PCC	65.5	0	9.5	15	23.5	17.5	0	0	0
PEC	15	0	0	0	0	0	6	6	3
OEC	12	0	0	0	0	0	6	3	3
PROJECTS/ MINI PROJ	12	0	0	0	0	1.0	1.0	4	6
SUM INTERN	3	0	0	0	0	0	0	3	0
	160	23	24	23	24.5	21	14.5	16	14

Total number of Mandatory Courses (MC): 03 (Indian Constitution, Environmental Science, Career Development Course)
*Mandatory Induction Program completes before the start of First year Semester-I.

Notations:

E1-S1: Engineering first year first semester
E1-S2: Engineering first sear second semester
E2-S1: Engineering second year first semester
E2-S2: Engineering second year first semester
E3-S1: Engineering third year first semester
E3-S2: Engineering third year second semester
E4-S1: Engineering fourth year first semester
E4-S2: Engineering fourth year second semester
SUM INTERN: Summer Internship program

Chapter – 2

Semester-Wise Structure of Curriculum

Mandatory Induction Program

3 Weeks Duration
Physical activity Creative Arts Universal Human Values Literary Proficiency Modules Lectures by Eminent people Visit to local areas Familiarization of Dept./Branch Innovations

ENGINEERING FIRST YEAR: SEMESTER-1					
SL NO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	BSC	22MA1101	Differential Equations and Multivariable calculus	3-1-0	4
2	BSC	22PY1101	Engineering Physics	3-1-0	4
3	BSC	22PY1181	Engineering Physics Lab	0-0-3	1.5
4	ESC	22CE1114	Engineering Graphics & Computer Drafting	1-0-2	2.5
5	ESC	22EE1101	Electrical Technology	3-1-0	4
6	ESC	22EE1181	Electrical Technology Lab	0-0-3	1.5
7	BSC	22EE1102	Introduction to Latest Technical Advancements	1-0-0	1
8	ESC	22CS1108	Programming & Data Structures	3-0-0	3
9	ESC	22CS1188	Programming & Data Structures Lab	0-0-3	1.5
Total Credits					**23**
Total contact hours : 28 hours					

ENGINEERING FIRST YEAR: SEMESTER-2					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	BSC	22MA1201	Mathematical Methods	3-1-0	4
2	PCC	22EC2102	Digital Logic Design	3-1-0	4
3	PCC	22EC2182	Digital Logic Design Lab	0-0-3	1.5
4	BSC	22EE1281	Computational Lab	0-0-3	1.5
5	HSC	22EG1281	English Language communication skills lab 1	1-0-3	2.5
6	ESC	22EC1201	Electronics Devices and Circuits	3-1-0	4
7	ESC	22EC1281	Electronics Devices and Circuits Lab	0-0-3	1.5
8	PCC	22EE1201	Network Theory	3-1-0	4
9	BSC	22EE1202	Introduction to AI	1-0-0	1
Total Credits					**24**
Total contact hours : 30 hours					

ENGINEERING SECOND YEAR: SEMESTER-1					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	BSC	22MA2101	Probability & Random Variables	2-1-0	3
2	ESC	22EE2182	Internet of Things Lab	0-0-3	1
3	PCC	22EC2101	Analog Electronic Circuits	3-1-0	4
4	PCC	22EC2181	Analog Electronic Circuits Lab	0-0-3	1.5
5	ESC	22CS1209	Object Oriented Programming	3-1-0	3
6	ESC	22CS1289	Object Oriented Programming Lab	0-0-3	1
7	PCC	22ECXXXX (To be filled after ECE BOS)	Signals & Systems	3-1-0	4
8	PCC	22EE2101	Electrical Machines	3-1-0	4
9	PCC	22EE2181	Electrical Machines Lab	0-0-3	1.5
Total Credits					**23**
Total contact hours: 31 hours					

ENGINEERING SECOND YEAR: SEMESTER-2					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	ESC	22EE2281	Robotics Laboratory	0-0-3	1
2	PCC	22EE2201	Power Systems-I	3-1-0	4
3	PCC	22EE2204	Machine Learning	3-0-0	3
4	PCC	22EE2202	Control Systems	3-1-0	4
5	PCC	22EE2282	Control Systems Lab	0-0-3	1.5
6	PCC	22EC2203	Linear Integrated Circuits	3-1-0	4
7	PCC	22EC2283	Linear Integrated Circuits Lab	0-0-3	1.5
8	PCC	22EE2203	Power Electronics	3-1-0	4
9	PCC	22EE2283	Power Electronics Lab	0-0-3	1.5
Total Credits					**24.5**
Total contact hours : 31 hours					

ENGINEERING THIRD YEAR: SEMESTER-1					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	PCC	22EC31XX (To be filled After BOS)	Digital Signal Processing	3-1-0	3
2	PCC	22EE3101	Power Systems-II	3-1-0	4
3	PCC	22EE3181	Power Systems Lab	0-0-3	1.5
4	HSC	22EG3182	English Language communication skills Lab-2	0-0-3	1.5
5	PCC	22EE3102	Electrical Vehicles	3-1-0	3
6	PCC	22EE3182	Electrical Vehicles Lab	0-0-3	1.5
7	PCC	22EC31XX To be filled After BOS	Embedded Systems	3-1-0	3
8	PCC	22EC31XX To be filled After BOS	Embedded Systems Lab	0-0-3	1.5
9	PROJ	22EE3190	Mini-Project-I (Socially Relevant Project)	0-0-2	1
10	HSC	22MG32XX	Product Design & Innovation	1-0-0	1
Total Credits					**21**
Total contact hours: 31 hours *Mini Project-1 workload not included in above workload calculation					

ENGINEERING THIRD YEAR: SEMESTER-2					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	HSC	22EG3283	English Language Communication skills lab-3	0-0-3	1.5
2	PEC	22EE32XX	Elective-1	3-0-0	3
3	PEC	22EE32XX	Elective-2	3-0-0	3
4	OEC	22XX32XX	Open Elective-1	3-0-0	3
5	OEC	22XX32XX	Open Elective-2	3-0-0	3
6	PROJ	22EE3290	Mini Project-II	0-0-3	1
Total Credits					**14.5**
MC		MC3201	Career Development Course	2-0-0	0
MC		MC3101	Indian Constitution	1-0-0	0
Total contact hours : 21 hours *Mini Project-2 work load not included in above calculation					

ENGINEERING FOURTH YEAR: SEMESTER-1					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	PEC	22EE41XX	Elective-3	3-0-0	3
2	PEC	22EE41XX	Elective-4	3-0-0	3
3	OEC	22XX41XX	Open Elective-3	3-0-0	3
4	PROJ	22EE41XX	Summer Internship Project	0-0-6	3
5	PROJ	22EE4190	Project – I	0-0-8	4
Total Credits					**16**
MC		22BE4101	Environmental Science	2-0-0	0
Total contact hours : 11 hours *Project-1 work load not included in above calculation *Summer Internship Project will be after completion of Engineering Third Year Semester-2					

ENGINEERING FOURTH YEAR: SEMESTER -2					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	HSC	22HS4299	Community Service	0-0-4	2
3	PEC	22EE42XX	Elective-5	3-0-0	3
5	OEC	22XX42XX	Open Elective-4	3-0-0	3
6	PROJ	22EE4290	Project-II & Dissertation	0-0-12	6
Total Credits					**14**
Total contact hours : 6 hours *Project-2 and Community Service work load not included in above calculation					

** Completion of courses through MOOCs is subjected to the regulations and guidelines of the University/Institute from time to time.
** At least two courses must be taken from Open Elective Courses

COURSES BEING OFFERED TO OTHER DEPARTMENTS

COURSE CODE	SUBJECT NAME	L-T-P	CREDITS	BRANCHES
22EEXX09	Basic Electrical and Electronics Engineering	X-X-X	X	MME, CE, CH, CSE, ME
22EEXX89	Basic Electrical and Electronics Engineering Laboratory	0-0-3	X	MME, CE, CH, CSE, ME

CHE: Department of Chemical Engineering
CE: Department of Civil Engineering
CSE: Department of Computer Science and Engineering
ME: Department of Mechanical Engineering
MME: Department of Metallurgy and Materials Engineering

CHAPTER 2
DETAILED 4-YEAR CURRICULUM CONTENTS SEMESTER-WISE

ENGINEERING FIRST YEAR: SEMESTER-I

22MA1101	**Differential Equations and Multivariable calculus**	**BSC**	**3L:1T:0P**	**4 credits**

Course Learning Objectives

- Discuss the solutions of first order differential equations.
- Discuss the solutions of higher order linear differential equations.
- Power series representation of functions and its validity.
- Understand continuity and differentiability of multi-variable functions and its applications to discuss maximum and minimum.
- Discuss the convergence Improper integrals and apply Leibnitz rule.
- Setup double and triple integral volume and surface area.

Course Content

Unit – I **(08 hours)**

Differential equations of first order and first degree

Basic concepts, Variable Separable method, homogeneous differential equations, Exact differential equations, Integrating factor, Differentiable equations Reducible to exact, Linear differential equations, Bernoulli differential equations.

Unit - II **(13 hours)**

Linear differential equations of higher order

Homogenous differentiable equations, Non-homogeneous linear equations of higher order with constant coefficients with RHS term of the type $e^{ax}, sinax, cosax, e^{ax}, sinax, cosax,$ polynomials in $x, e^{ax}\ V(x), xV(x), x, e^{ax}\ V(x), xV(x),$ Method of variation of parameters, Euler Cauchy equation.

Unit - III **(8 hours)**

Sequences and Series

Sequences and their limits, Convergence of series, Comparison test, Ratio test, Root test, Absolute and Conditional convergence, Alternating series, Power series, Taylor's and Maclaurin's series.

Unit - IV **(16 hours)**

Functions of several variables

Limit, Continuity and Differentiability of functions of several variables, Partial derivatives and their geometrical interpretation, Differentials, Derivatives of Composite and Implicit functions, Chain rule, Jacobians, Derivatives of higher order, Homogeneous functions, Euler's theorem, and Harmonic functions, Taylor's expansion of functions of several variables, Maxima and Minima of functions of several variables - Lagrange's method of multipliers.

Unit - V **(5 hours)**

Beta and Gamma Function:

Beta and Gamma functions - elementary properties, differentiation under integral sign, and differentiation of integrals with variable limits - Leibnitz rule.

Unit – VI **(10 hours)**

Multiple Integrals

Rectification, Jacobians of transformations, double and triple integrals, computations of surface and volumes, change of variables in double integrals - integrals dependant on parameters - applications.

Learning Resources

Text book

Erwin Kreyszig**, '***Advanced Engineering Mathematics'*, 9th Edition, Wiley-India.

Reference books

Tom M. Apostal**, '***Calculus*', Volume II, Second Edition, Wiley-India.

R. K. Jain And S. R. K. Iyengar, '*Advanced Engineering Mathematics*', 3rd Edition, Narosa Publishers.

B.S.Grewal**, '***Higher Engineering Mathematics'*, 42nd Edition, Khanna Publishers.

Web resources

Dr. Srinivasa Rao Manam, NPTEL-IIT Madras, '*Introduction to ordinary differential equations*'. URL: https://nptel.ac.in/courses/111106100/12

Prof Sudeeptha Dutta, NPTEL-IIT Kanpur, '*Differential Calculus of Several Variables'*. URL: https://nptel.ac.in/courses/111104092/11

Dr S K Gupta, NPTEL-IIT Roorkee, '*Multivariable Calculus*'. URL:https://nptel.ac.in/courses/111107108/

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

CO 1	Solve first order differential equations
CO 2	Solve higher order linear differential equations
CO 3	Check the convergence of infinite series and discuss the power series representation of a function at various points
CO 4	Explain limits and continuity, differentiability and partial derivatives of functions of multivariable and find the extremum of functions subjected to constraints.
CO 5	Apply Leibnitz rule and beta gamma functions to evaluate improper integrals
CO 6	Find surface area and volume by using double and triple integrals,

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

****

ENGINEERING FIRST YEAR: SEMESTER-I

22PY1101	**Engineering Physics**	**BS C**	**3L:1T:0P**	**4 credits**

Course Learning Objectives:

- To impart basic knowledge on the concept of vector and scalar fields as well its physical significance in all 3D coordinate systems. To integrate knowledge on vector calculus and its applications to transform 1, 2 and 3 dimensions.
- To enable the student in detailed knowledge on Gauss's Law in electrostatics and it'sapplications how to calculate electric field associated by different symmetrical charge distributions. And also impart basic fundamentals on dielectric materials and induced polarizations associated by the presence of external electric field on dielectrics.
- To impart basic idea on solving problems by using Poisson's and Laplace equations of different electrical charged bodies and also create knowledge on boundary conditions of electric fields and potentials.
- To enhance in detail knowledge on magnetic force due to current carrying charged bodies and Amphere's law as well its applications. To integrate in detail knowledge on magnetic materials and its properties as well applications.
- To get physical ideas contained in Maxwell's equations, and how the symmetry between changing electric andchanging magnetic fields explains Maxwell's prediction of electromagnetic waves in different medium.
- To gain fundamentals on band theory of solids, semiconductors materials its classification by Fermi energy level and band gap. To get basic knowledge on electronic devices fabricated with semiconductors, i.e. P-N diode, LED's, Photo diodes and solar cells and its working principle as well characteristics.

Course Content:

UNIT - I: Introduction (09 Hours)

Coordinate system: Cartesian, cylindrical and spherical coordinate system transformations, Differential Calculus: Gradient, Divergence, Curl and their physical significance, Integral Calculus: Line, Surface, and Volume Integrals, Integral theorem: Gauss and stokes theorems, Curvilinear Coordinates, second derivatives: Laplacian.

UNIT-II: Electrostatics -1 (09 Hours)

Gauss's Law and applications, electric Potential, Gradient relationship between E and V, Electric Dipole, Energy Density in Electrostatic Fields, Fields inside Perfect Conductors, Polarization Dielectrics, Dielectric Constant, capacitance, Dielectric break down.

UNIT-III: Electrostatics -2 **(09 Hours)**

Current density, Ohm's law, Poisson's and Laplace equations. Boundary conditions of electric field and electrostatic potential, method of images (with one example), energy of a charge distribution and its expression in terms of electric field.

UNIT-IV: Magnetostatics **(10 Hours)**

Magnetic Forces, Biot-Savart's Law, Steady currents, Ampere's Law, Magnetic Vector Potentials, Magnetization, Permeability, Para , Dia, Ferro-Magnetic material properties, Magnetic Energy, boundary conditions, Scalar & vector fields.

UNIT-V: Time varying fields **(9 Hours)**

Faraday's Law, Lenz's law, EMF, Displacement current, Maxwell's equation in vacuum and non-conducting medium and conducting medium, Energy in an electromagnetic field; Flow of energy, Poynting's theorems and conservation Laws.

UNIT-VI: Semiconductor physics **(14 Hours)**

Introduction to Quantum Mechanics: De Broglie matter waves, Uncertainty Principle, Wave function& it's probability interpretation, Postulates of quantum mechanics, Time independent Schrodinger Equation and its Applications, Particle in a box (1-D and 3-D)

Semiconductor: Electron in periodic structures, Band theory of solids, Density of states, Fermi level, Band theory of semiconductors, effective mass, Direct and indirect band gap, carriers in intrinsic and extrinsic semiconductors, Charge densities in intrinsic and extrinsic semiconductor, Law of mass action, Hall Effect, Generation and Recombination of charges, Diffusion, the continuity equation, Injected minority carrier charge, Potential Variation within a graded semiconductor, P-N diode, LED's, Photo diodes and solar cells.

Learning resources

Textbook:

David J. Griffiths '*Introduction to Electrodynamics'* HPI Publications, 3rd edition
Elements of electromagnetics by Mathews N.O. Sadiku , 3rd Edition

Reference Books:

1. S.L. Kakani, Subhadra Kakani '*Engineering Physics'*, CBS Publications, 2nd edition
2.Arunkumar *'Introduction to solid state physics'* HPI Publications, (30 January 2010)
Iswar Singh Tyagi *'Principles of quantum mechanics'* Pearson Publications; 1st edition (25 September 2012)
Donald Neamen *'Semiconductor devices'* McGraw Hill Education; 3ed edition (25 August 2006)

Web resources:

Prof V. Ravi Shakar, NPTEL-IIT Kanpur, '*Engineering Physics-II*' URL:
https://nptel.ac.in/courses/122104016/

Prof. D. K. Ghosh, NPTEL-IIT Bombay, '*Engineering Physics-II'*
URL: https://nptel.ac.in/courses/122101002/

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

CO 1	The student will have capacity to integrate knowledge on vector and scalar fields using mathematical del operators, and also solve the problems in integral calculus.
CO 2	Student will have capacity to describe the electric field and potentials associated various symmetric charged bodies by using Gauss Law. And also understand the applications of dielectric materials in real life.
CO 3	Student will be able understand different electrical charged body fields, potentials, energy density and boundary conditions by solving Poisson's and Laplace equations.
CO 4	Student will have capacity to distinguish different magnetic materials such as Dia, para and ferro (Ferri) materials and its applications.
CO 5	Student will have capacity to describe Maxwell's equation in vacuum and conducting and non-conducting media.
CO 6	Student will have capacity to describe classification of solid state materials in band theory, semiconducting materials and its significance in basic electronic devices.

Course Nature		**Theory**		
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING FIRST YEAR: SEMESTER-I

22PY1181	**Engineering Physics Laboratory**	**BSC**	**0L:0T:3P**	**1.5 credits**

Course Learning Objectives

- Hall Effect: To determine the hall coefficient, carrier density and carrier mobility of a given semiconductor.
- Frank Hertz: To verify the postulates of Bohr's theory and Quantization energy.
- Photo electric Effect: To study the photoelectric effect and Determine the value of Plank's constant value.
- Energy gap of Semiconductor: Determine the energy gap of a given semiconducting material.
- Susceptibility of Para Magnetic Materials: Determine the susceptibility of a given paramagnetic solution by Quinck's tube method.
- Magnetic hysteresis curve tracer: Determine the Coercivity, Saturation magnetization and Retentivity of a given Ferro magnetic material using a Hysteresis loop tracer.
- Dielectric Constant measurement: Determine the Dielectric constant of a given dielectric material.
- Viscosity of water Measurement: Determine the co-efficient of viscosity of given oil by falling sphere method.
- Verification of I-V characteristics of Zener Junction Diode and Determination break down voltage of Zener Diode.
- Determine the parameters in common emitter configuration in pnp and npn Transistor
- Determine the efficiency of Solar cell

List of Experiments

Exp-1: Hall Effect
Exp-2: Frank Hertz
Exp-3: Photo electric Effect
Exp-4: Energy gap of Semiconductor
Exp-5: Susceptibility of Para Magnetic Materials
Exp-6: Magnetic hysteresis curve tracer
Exp-7: Dielectric Constant measurement
Exp-8**:** Viscosity of water Measurement
Exp-9: Verification of I-V characteristics of Zener Junction Diode and Determination break down voltage of Zener Diode.
Exp-10: ***p-n-p*** and ***n-p-n*** Transistor parameters in common emitter configuration
EXP-11: Calculating the efficiency of Solar cell

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

CO 1	Student will able to understand hall coefficient, carrier density and carrier mobility of a given semiconductor.
CO 2	Student will able to understand Quantization of energy
CO 3	Student will able to understand the photoelectric effect and calculation of Plank's constant value.
CO 4	Student will able to understand the energy gap of a semiconductor
CO 5	Student will able to understand the susceptibility of a given paramagnetic solution by Quinck's tube method.
CO 6	Student will able to understand the Magnetic hysteresis curve tracer
CO 7	Student will able to understand measurement of dielectric constant
CO 8	Student will able to understand the co-efficient of viscosity of given oil by falling sphere method
CO 9	Student will able to understand the I-V characteristic of Zener diode and Zener breakdown
CO 10	Student will able to calculate the transistor parameters
CO11	Student will able to calculate the efficiency of solar cell

Assessment Method

Assessment Tool	Experiments	Record	Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	5%	10%	40%
End Semester Examination weightage (%)				60%

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ENGINEERING FIRST YEAR: SEMESTER-I

22CE1114	**Engineering Graphics and Design**	**ESC**	**1L: 0T: 3P**	**2.5 credits**

Course Learning Objective:

- To know about emergence of Engineering Graphics as a refined communication tool and to be aware of International and national standards of practice for uniform presentation of drawings.
- To adopt the projection of three dimensional object orthogonally on a set of vertical and horizontal planes and obtain the views of the frontal and the top surfaces.
- To describe the position of a point and position of the line with respect to all the planes of projection and obtain itsviews.
- To learn orthographic projections of various simple plane surfaces in simple and inclined positions.
- To know about orthographic projections of right and regular solids in simple positions, when their axes are perpendicular to one reference plane and parallel to theother.
- To learn about types of cutting planes and to obtain views of simplesolids.
- To learn about different methodologies to be used for obtaining the two dimensional layout of the lateral surfaces of uncutsolids.
- To learn about computer aided drafting techniques and to be familiarize with one of the most powerful Software Auto CAD

Course content:

Unit-I **(7 hours)**

Introduction to Engineering Drawing

Introduction toEngineeringdrawing Tools and Standards, Geometric Constructions, Scales, Conics and Special Curves - ellipse, parabola, hyperbola, cycloids,Involutes.

Unit-II **(6 hours)**

Orthographic projections

Introduction to Orthographic Projections, Projections of Points, Projection of Lines.

Unit-III **(8 hours)**

Projection of Solids

Projection of Planes, Projections of Solids cube, prism, pyramid, cylinder, cone and sphere.

Unit-IV **(8 hours)**

Section of solids

Sections of Solids - cube, prism, pyramid, cylinder, cone and sphere. Development of Surfaces

Parallel line method and Radial linemethod.

Unit-V **(8hours)**

Introduction to AutoCAD

ComputerAidedDesign Introduction to AutoCAD, Co-ordinate System (UCS) and their Commands, Basic Commands of Drawing and Editing, Dimensioning andText.

Unit-VI **(8 hours)**

Computer Graphics

Drawing practice with AutoCAD Creating 2D Drawings of Objects from Isometric views, Creating Isometric views form Orthographic views and Introductions to 3D drawings.

Learning Resources Textbooks

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), *'Engineering Drawing'*, Charotar Publishing House.

Reference books

Shah, M.B. &Rana B.C. (2008), *'Engineering Drawing and Computer Graphics'*, PearsonEducation.
Agrawal B. & Agrawal C. M. (2012), *'Engineering Graphics'*, TMHPublication.

Web resources

Prof Anupam Saxena, NPTEL-IIT Kanpur, 'Engineering Drawing'.
URL:https://nptel.ac.in/courses/112104172/
Prof Anupam Saxena, NPTEL-IIT Kanpur, 'Computer Aided Engineering Design'.
URL:https://nptel.ac.in/syllabus/112104031/

Course outcome: After the completion of this course, the student will be able to

CO 1	Student will be aware of International and national standards of practice.
CO 2	Student willbefamiliarwith obtaining the views of the frontaland the top surfaces of an object
CO 3	Student will be aware of orthographic projections of right and regular solids in simple positions, when their axes are perpendicular to one reference plane and parallel to the other.
CO 4	Student will know about computer aided drafting techniques and will be familiar with one of the most powerful software 'AutoCAD'

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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ENGINEERING FIRST YEAR: SEMESTER-I

22EE1101	**Electrical Technology**	**ESC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objectives

- To make understand the concept of discrete electronics & electrical components and fundamental laws associated with it along with circuit laws.
- To make understand the concept of the DC circuits using theorems
- To make understand the concept of Single Phase and Three phase circuits
- To make understand the concept of DC machines

Course Content

Unit-I **(12 hours)**

Circuit Concepts, R,L,C Parameters & Elements, Voltage and Current Sources, Independent and Dependent Sources, Kirchhoff's Laws, Network Reduction Techniques – Series, Parallel, Series Parallel, Star–to-Delta or Delta-to-Star Transformations, Nodal Analysis, Mesh Analysis, Super node and Super mesh for DC Excitations. (Only with Independent sources)

Unit-II **(8 hours)**

Tellegen's Theorem, Source Transformations, Superposition Theorem, Thevenins, Norton and Maximum Power Transfer Theorem.

Unit-III **(10 hours)**

Introduction to AC, calculation of R.M.S and average values. Steady State Analysis of R, L, C elements (in Series, Parallel, Series-Parallel Combinations) with sinusoidal excitation. Concept of Reactance, Impedance, Susceptance and Admittance. Phase and Phase difference, concept of Series Resonance. Concept of Power Factor, Real and Reactive powers. Complex and Polar forms of representation, Complex power.

Unit-IV **(10 hours)**

Phase Sequence- Star and Delta connection-Relation between Line and Phase Voltages and Currents in Balanced Systems-analysis of Balanced Three Phase Circuits – Phasor Diagrams-Measurement of active and reactive Power in Balanced Three Phase Systems. Two Wattmeter Method of Measurement of Three Phase Power.

Unit-V **(10 hours)**

Introduction to simple series magnetic circuits, Construction and Principle of Operation of Single Phase Transformers, on no load. Ideal and practical transformer equivalent circuits, transformer losses, transformer testing: sc and oc testing, efficiency and voltage regulation.

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Unit-VI **(10 hours)**

Principles of electromechanical energy conversion and basic concepts of rotating machines. Principle of Operation of DC Machines, DC Motors, Types of Motors, Characteristics-Losses and Efficiency. Speed Control of DC Shunt Motor, Flux and Armature Voltage Control Methods. Applications of DC motors.

Learning Resources

Text Books

Charles Alexander and Matthew Sadiku, *'Fundamentals of Electric Circuits'*, McGraw-Hill Education; 5th edition ,2012

WH Hayt JE Kemmerly and S M Durbin, *'Engineering circuit analysis'*, McGraw-Hill Book Company Inc, (8th Edition), 2013.

Reference Books

DP Kothari and I.J Nagrath, *'Basic Electrical Engineering'*, McGraw-Hill Education (3rd edition) 2010.

Vincent Del Toro, *'Electrical Engineering Fundamentals'*, Pearson 2nd Edition.

Hughes, *'Electrical and Electronic Technology'*, Pearson 10/E 2011.

Web resources

Prof U Umanand, IISC Bangalore, *'Basic Electrical Technology'*.
URL: http://nptel.ac.in/courses/108108076/

Prof S Aniruddhan, IIT Madras, *'Basic Electrical Circuits'*.
URL: https://onlinecourses.nptel.ac.in/noc16_ee03

Prof Anant Agarwal, Masuchussets Institute of Technology, *'Circuits and Electronics'*.
URL: https://6002x.mitx.mit.edu/courseware/6.002_Spring_2012/

Prof N C Jagan, RGUKT Video content, 'Electrical Technology'.

Course Outcomes

At the end of the course, the student will be able to

CO 1	Use ohms laws, Kirchhoff's laws on passive elements
CO 2	Analyze circuits made up of linear lumped elements. Specifically, analyze circuits containing resistors and independent sources using techniques such as the node method, superposition and the Thevenin's method
CO 3	Analyze the Single phase AC circuits
CO 4	Analyze the Three phase AC circuits
CO 5	Analyze DC and AC machines and
CO 6	To understand speed control techniques and power electronic applications.

Assessment Method

Assessment Tool	Weekly tests/Assignments (in a semester)	Monthly tests (in a semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

ENGINEERING FIRST YEAR: SEMESTER-I

22EE1181	**Electrical Technology Laboratory**	**ESC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective:

To get a hands-on experience on the concepts in Electrical Technology theory course and thereby developing practical knowledge in analysis of electrical equipments like motors, generators etc.

List of Experiments

- Familiarization with supply panel (AC & DC), all measuring instruments, auto transformers (1-φ and 3- φ), Name plate specifications of all machines.
- Verification of KVL and KCL.
- Verification of network theorems. (Superposition and Thevenin's Theorem)
- Calibration of Single Phase Energy Meter.
- Study the behaviors of series RLC circuit.
- Characteristics of lamps
- Three phase power measurement by two Wattmeter method.
- Speed control of D.C Shunt Motor using Field and Armature control.
- O.C. and S.C. tests on a single phase transformer
- Lab project

Course outcome

After the completion of this laboratory course, the student will be able to

CO1	Understand the AC and DC power supplies and their measurement practices
CO2	Analyze the circuits using Kirchoff's voltage and current laws
CO3	Understand the working of Energy Meter, Power measurement techniques
CO4	Analyze the working principles of motors and generators
CO5	Understanding the concept of loadline by experimental analysis
CO6	Able to understand and analyze the real-time problems of Electrical Technology applications

Assessment Method

Assessment Tool	Experiments	Record	Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	5%	10%	40%
End Semester Examination weightage (%)				60%

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ENGINEERING FIRST YEAR: SEMESTER-I

22EE1102	**Introduction to latest technological advancements**	**BSC**	**1L: 0T: 0P**	**1 credit**

Course Learning Objective

- To know the emerging technology trends related in the Electrical & Electronics Engineering domain.
- To know the other interdisciplinary domains connected with Electrical & Electronics Engineering.
- To gain knowledge on the recent Industrial advancements

Course content

Exercise-I: ICT in Engineering Education (MOOCs), Interactive Education tools, Social networking for Education, ICT for societal development.

Exercise-II: Understanding the latest Mobile Phone Hardware system: Study of sensors, display, memory, processor functionality and other features.

Exercise-III: Introduction to Internet of Things (IoT), Emphasis on Electrical & Electronics field in IoT, challenges and applications.

Exercise-IV: Introduction to Artificial Intelligence, robotics and Machine learning applications and challenges.

Exercise-V: Advancements in power systems such as smart grid technology etc.

Exercise-VI: Advancements in power electronics and drive, electric vehicles, etc.

Exercise-VII: Recent advancements in VLSI and Signal Processing domains, others.

Note: Invited talks by industry experts may be arranged as part of this course.

Learning Resources

Magazines
Electrobits magazine.
DRDO/ISRO/NASA Newsletters and magazines.
Industry newsletters and magazines.

Web resources
NPTEL/SWAYAM/Coursera/Udemy/
Flipboard apps/TED app/ Educational apps etc
https://spectrum.ieee.org/
https://www.eetimes.com/
https://www.digit.in/
https://www.ecnmag.com/
https://www.techdesignforums.com/

Course outcome: After the completion of this course, the student will be able to

CO 1	Understand the scope of Electrical & Electronics Engineering in real-time applications
CO2	Understand the various available resources so as to get updated with the current technology trends
CO3	Understand the current technology trends across different domains – Government sectors and Industries

Assessment Method(Internal)

Assessment tool	Seminar	Report submission (End Semester)	Total
Weightage (%)	75%	25%	100%

*Note:
1. The topics in the course may vary as per the recent technical trends of the Industry. However, the changes are subject to the approval of the Institute competent authorities.
2. Industry personnel/People from ISRO/DRDO/Research Center are recommended to engage in this course.
3. In the Assessment Method, during one of the monthly seminars, the student is supposed to submit a video recording of the seminar and the same should be played in the classroom.

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ENGINEERING FIRST YEAR: SEMESTER-I

22CS1108	**Programming and Data Structures**	**ESC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives:

- To deduce adequate knowledge in programming language and problem-solving techniques.
- To develop programming skills using the fundamentals of C Language.
- To recognize the effective usage of arrays, structures, functions, pointers.
- To implement the memory management concepts.
- To illustrate the usage of pointers and dynamic memory allocation.
- Explore Data Structures and its applications.

Course Content

Unit- I **(5 hours)**

Introduction

Computer Hardware, Bits and Bytes, History of Programming Languages, Character Set, Variables and Identifiers, Built-in Data Types. Operators and Expressions, Constants and Literals, Simple Assignment Statement, Basic Input/output Statement, Simple 'C' Program, Conditional Statements and Loops.

Unit – II **(6 hours)**

Arrays

One Dimensional Arrays, Array Manipulation, Searching, Insertion, Deletion of An Element from An Array; Finding the Largest/Smallest Element in An Array; Two Dimensional Arrays, Addition/Multiplication of Two Matrices, Transpose of square Matrix, Inverse of Matrix, Character Arrays, Multi-dimensional arrays.

Unit – III **(8 hours)**

Functions

Function Declaration, Function Definition, Function Call, Call by Value, Call by Reference, Recursion, String Fundamentals, String Handling Functions.

Unit - IV **(8 hours)**

Structure & Union

Structure Variables, Initialization, Structure Assignment, Nested Structure, Structures and Functions, Structures and Arrays: Arrays of Structures, Structures Containing Arrays, Unions.

Unit - V **(8 hours)**

Pointers

Pointer Type Declaration, Pointer Assignment, Pointer Initialization, Pointer Arithmetic, Functions

and Pointers, Arrays and Pointers, Pointer to Pointers, Dangling Memory, Dynamic Memory Allocations, Storage Classes.

Unit – VI **(10 hours) Data Structures**

Linked List, Double Linked Lists, Stack, Stack Implementation Using Arrays, Stack Implementation Using Linked List, Queues, tree traversals.

Learning Resources

Text book

ReemaThareja, *'Data Structures using C'*, Oxford Higher Education,2nd Edition.

Reference Books

W. Kernighan, Dennis M. Ritchie, *'C Programming Language',* Prentice Hall India Learning Private Limited, 2nd Edition.

Balagurusamy, *'Programming in ANSI C',*McGraw Hill Education India Private Limited; 7th Edition.

Yashavant Kanetkar, *'Let us C',* BPB Publications,14th Edition

Web resources

Prof Satyadev Nandakumar, NPTEL-IIT Kanpur, *'Introduction to Programming in C'*, URL: https://nptel.ac.in/syllabus/106104128/

Dr P P Chakraborty, NPTEL-IIT Kharagpur, *'Programming and Data Structures'*

URL: https://nptel.ac.in/courses/106105085/4

URL: https://www.tutorialspoint.com/cprogramming/

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

CO 1	Illustrate the flowchart and design an algorithm for a given problem and to develop one C program using Operators.
CO 2	Develop conditional and iterative statements to write C Programs.
CO 3	Describe C Programs that use the arrays and its usage.
CO 4	Exercise user defined functions to solve real time problems.
CO 5	Describe C Programs using pointers and to allocate memory using dynamic memory management functions.
CO 6	Explore different data structures and understand.

Assessment Method

Assessment Tool	Weekly tests/Assignments (in semester)	Monthly tests (in semester)	End Semester Test	Total

Weightage (%)	10%	30%	60%	100%

ENGINEERING FIRST YEAR: SEMESTER-I

22CS1188	**Programming and Data Structures Laboratory**	**ESC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

- Understand the basic concept of C Programming and Data Structures, its different modules that include conditional and looping expressions, Arrays, Strings, Functions, Structures, Files, Stacks and Queues.
- Acquire knowledge about the basic concept of writing a program.
- Purpose of programming language and its application in problem solving.

List of Experiments

Exercise-1: Introduction to C, Conditional Statements and Loops
C Program to calculate the sum of Natural numbers.
C Program to generate multiplication table of a given number.
C Program to display Fibonacci sequence (Up to given number).
C Program to Check whether a given number is prime or not.
C Program to make a simple Calculator using switch case.
C Program to check whether a number is palindrome or not.
C Program to display factors of a given number.
C Program to print Pyramids, Triangles and various patters using loops.

Exercise-2: **Arrays and Sorting**
C Program to find second largest Element of an Array.
C Program to add two matrix using multi-dimensional arrays.
C Program to multiply two matrix using multi-dimensional arrays.
C Program to find transpose of a matrix.
C Program to Sort Elements of an Array using Bubble sort.
Using Insertion Sort, Selection Sort.
Using Counting Sort, Bucket Sort 8. Check whether two strings are anagram of each other or not.

Exercise 3: **Functions and Recursion**
C Program to check whether given number is prime or not using user-defined function.
C Program to swap two integer values using call by value and call by reference.
C Program to find the factorial of a given number using recursion.
C Program to calculate length of string without using strlen() function.
C Program to print all permutations of a string (abc, acb, bac, bca, cab, cba).

C Program to sort elements in Lexicographical order (Dictionary order) using in built string functions.
Sorting using Merge Sort.
Sorting using Quick Sort.

Exercise-4: **Structues and Unions**
C Program using structures to read and display the information about a student.
C Program to read, display, add and subtract two complex numbers.
C Program to read and display the information of a student using nested structure
C Program, using an array of pointers to a structure, to read and display the data of students.
C Program to demonstrate arrays of Union variables.
C Program using structures to maintain a book library (Book is a structure) which has following operations print various types of books along with their count, author details, search a book by author name or book name or publisher.

Exercise-5: **Pointers and File Handling**
C Program to demonstrate, handling of pointers in C.
C Program to access array elements using pointers.
C Program to find the sum of n numbers with arrays and pointers.
C Program to swap two numbers using pointers and function
C Program to find sum of n elements entered by user. To perform this allocate memory dynamically using malloc() function.
C Program to read and write a file.
C Program to count number of lines and words.
Write a c program to copy a data of file to other file.

Exercise-6: **Introduction to Data Structures**
Write a program to create a linked list and perform insertions and deletions of all cases. Write functions to sort and finally delete the entire list at once.
Write a program to create a doubly linked list and perform insertions and deletions in all cases.
Write a program to perform push, pop and peek operations on a stack.
Write a program to implement a linked stack.
Write a program to implement a linked queue.
Write a program to implement binary search tree insertion.
Write a program to implement binary search tree traversals (pre-order, post-order, in-order).

Lab project

Course outcome: After the completion of this Laboratory course, the student will be able to

CO 1	Apply and practice logical ability to solve the problems
CO 2	Understand C programming development environment, compiling, debugging, executing a program using the development environment
CO 3	Analyzing the complexity of problems, modularize the problems into small modules and then convert them into programs
CO 4	Understand and apply the in-built functions and customized functions for solving the problems
CO 5	Understand and apply the pointers, memory allocation techniques and use of files for dealing with variety of problems
CO 6	Understand and apply the structures and unions concept and solving problems on the same
CO 7	Understand the basic concepts of stacks, queues and applying the same for basic problems

Assessment Method

Assessment Tool	Experiments	Record	Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	5%	10%	40%
End Semester Examination weightage (%)				60%

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ENGINEERING FIRST YEAR: SEMESTER-II

22MA1201	**Mathematical Methods**	**BSC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objectives:

- The objective of this course is to introduce vector spaces and linear transformation.
- Discuss Eigen values and Eigen vectors of a matrix and various properties.
- Setup double and triple integrals to find volume and surface area.
- Discuss directional derivatives and application of Green's, Stokes and Gauss theorems.
- Discuss numerical methods to find the roots of transcendental equations and Interpolation.
- Evaluate integrals by using numerical methods and solving IVP.

Course Content:

Unit – I: Linear Algebra: (12 hours)
Vector Spaces, Linear Combinations of Vectors, Linear dependence and Independence, Basis and Dimension, Linear Transformations, Matrix Representations of Linear transformation.

Unit – II: Eigen values and Eigen vectors: (8 hours)
Solving system of Homogeneous and Non-Homogeneous equations by using Gauss elimination method. Characteristic roots and Characteristic Vectors of a matrix - Cayley-Hamilton Theorem (without proof); Finding inverse and power of a matrix by Cayley-Hamilton Theorem.

Unit-III: Multiple integrals: (10 hours)
Double and triple integrals, computations of surface and volumes, Jacobeans of transformations, change of variables in double integrals, Change of Order of double integrals, integrals dependant on parameters - applications.

Unit–IV: Vector calculus: (12 hours)
Scalar and vector fields, level surfaces, directional derivative, Gradient, Curl, Divergence, Laplacian, line, surface integrals and Volume integrals, Green, Gauss and Stokes theorems (without Proof) and problems.

Unit – V: Root finding Methods and Interpolation: (10 hours)
Roots of polynomial and transcendental equations – bisection method, Regula-falsi method and Newton- Raphson method, Finite differences, Newton's forward and backward interpolation formulae.

Unit – VI: Numerical integration and numerical solution of IVP: (8 hours)
Trapezoidal rule, Simpson's $1/3^{rd}$ rule and $3/8^{th}$ rule for numerical integration, Solution of IVP by Euler and Runga-Kutta method.

Learning resources Text book:

1. ERWIN KREYSZIG, '*Advanced Engineering Mathematics'*, Wiley-India, 9th Edition.

Reference Books:
R. K. Jain and S. R. K. Iyengar, '*Advanced Engineering Mathematics',* Narosa Publishing House, New Delhi, 3rd Edition.
B.S.Grewal, '*A Text Book of Higher Engineering Mathematics'*, Khanna Publishers, 43rd Edition.
Gilbert Strang , 'Linear Algebra and its Applications', CENGAGE Learning 4th Edition.
Web resources:
https://onlinecourses.nptel.ac.in/noc20_ma54/preview
https://onlinecourses.nptel.ac.in/noc21_ma11/preview
RGUKT content

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

CO 1	Write Matrix representation for transformations.
CO 2	Find Eigen values and Eigen vector for a Matrix.
CO 3	Setup and evaluating double and triple integrals.
CO 4	Apply Green's Stokes and Gauss Divergence Theorems.
CO 5	Approximate the roots of polynomial and transcendental equations.
CO 6	Approximate the Integral value by numerical methods and solve IVP using numerical methods.

For Theory courses only:

Course Nature		**Theory**		
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING FIRST YEAR: SEMESTER-II

22EC2102	**Digital Logic Design**	**PCC**	**2L: 0T: 0P**	**4 credits**

Course Learning Objective

- To discuss the concepts of Number systems and representations used in the computers, combinational design, sequential designs and complete system design at gate-level abstraction
- To discuss the important features of IC design like area, power and delay.
- To design a simple digital system at gate-level as per the design specifications.

Course Content

Unit-I **(6 hours)**

Number systems-Representations-Conversions, Boolean constants and variables, basic gates: operation and truth tables, describing logic gates algebraically, evaluating logic circuit outputs, implementing circuits from Boolean expressions, universality of gates, Boolean theorems, Demorgan's theorems, alternate logic gate representations, IEEE/ANSI standard logic symbols.

Unit-II **(12 hours)**

Combinational circuit minimization using Boolean laws and Karnaugh maps, multi-level synthesis, timing hazards, logic levels and noise margins, Fan-out, Fan-in. Single bit adders and subtractors, multi-bit adders, BCD adder, multi-bit subtraction using adders, signed multiplier, unsigned multiplier, code converters, parity bit generators/checkers, magnitude comparator. Delay, Area and Power analysis in combinational circuit designs. Conversion of real-time statements into Boolean expressions and design of gate-level logic circuits.

Unit-III **(10 hours)**

Bistable elements, Latches and Flip-flops : S-R latch , S' – R' Latch, S-R latch with enable, D latch, Race-around condition and elimination methods. Edge triggered D flip flop, Edge triggered D flip flop with asynchronous inputs, master-slave flip-flop, edge triggered J-K flip-flop with asynchronous inputs, T flip-flops. Excitation tables, Characteristic equations.
Flip-flop timing consideration: set-up time, hold-time discussion using positive edge-triggered D-Flip flop.

Unit-IV **(14 hours)**

Frequency division and counting. Design and analysis of asynchronous counters, Delay considerations and limitations on maximum clock frequency, Design and analysis of synchronous counters. BCD counter, Ring counter, Johnson counters. State diagram overview (Present States, Next states, Present outputs, Present inputs). Serial / Parallel data transfer registers: PIPO register,

SISO register, PISO register, SIPO register.

Unit-V **(10 hours)**

Decoders: Binary decoder, synthesis of logic functions using decoders, cascading binary decoders, seven-segment decoders, applications.
Multiplexers: synthesis of logic functions using multiplexers applications.
Demultiplexers: Realization, 1-4 and 1-8 line demultiplexers, demultiplexer tree. Encoders: Priority encoders. Implementation of functions using programmable logic devices: PAL, PLA, PROM.

Unit-VI **(8 hours)**

Memory – Structure and Timing: Static RAM, Dynamic Ram. Architecture: CPLD, FPGA
Design and analysis of Digital circuits: Digital Clock, Digital calendar, Traffic light controller, Mobile number sequence generators and other relevant topics

Learning Resources

Text books

Ronald J Tocci, Neal S.Widmer, Gregory L.Moss, *'Digital systems'* Pearson 10th edition.
John F.Wakerly, *'Digital Design'* , Pearson 4th edition

Reference books

Stephen Brown, Zvonko Vranesic, *'Fundamentals of Digital Logic with Verilog Design'*, TMH, 2nd edition.

Web Resources

Prof. Shankar Balachandran, NPTEL-IIT Madras, *'Digital Circuits & Systems'*
URL: https://nptel.ac.in/courses/117106114/
Prof. S Srinivasan, NPTEL-IIT Madras, *'Digital Circuits and Systems'*
URL: https://nptel.ac.in/courses/117106086/

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

CO 1	Apply the knowledge of simplification in obtaining optimal digital circuits
CO 2	Study and examine the SSI, MSI, LSI and Programmable elements
CO 3	Analyse the operation of synchronous and asynchronous state machines
CO 4	Design any combinational or sequential digital circuits to meet the given specifications
CO 5	Analyze any digital circuit and to debug such circuit
CO 6	Prototype a real time application on EDA tool

Assessment Method

Assessment Tool	Weekly tests/Assignments (in a semester)	Monthly tests (in a semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

ENGINEERING SECOND YEAR: SEMESTER-I

22EC2182	**Digital Logic Design Laboratory**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

- Expose the student to the concepts of Digital System Design and itsapplications
- To understand the practical aspects of combinational and sequential circuitdesign
- To design a prototype digital logic designsystem
- .

List of Experiments

- Familiarization logic gate levels understand the concept of noise- margin. Troubleshooting digitalcircuits.
- Design of code converters and comparators (8-bit) on breadboard.
- Adder related experiments: Half adder , full adder , half subtractor, full subtractor , ripple carry adder, BCD adder, carry look ahead adder usingIC.
- Design of a binary multiplier and displaying its inputs and outputs on seven segment displayunit.
- Design and verification of SR, JK, D, T latch/flip-flops. Verification and elimination of Race AroundCondition.
- Flip-flop conversions and Design of frequencydividers.
- Design of synchronous counters (Up and Down) and displaying result on seven segment display unit
- Design n counter design (total 8 states design of mod 6, 7 with clear)
- mod7 with clear).
- Design and IC verification of Decadecounter.
- Cascading of counters.
- Synchronous counter design and displaying result on seven segment display unit
- Random sequence.
- Ring counter/Johnsoncounter.
- Familiarization with multiplexer, decoder, encoder. Design of Half adder, full adder, magnitude comparator and other examples using above familiarized components.
- Design of a mobile number sequence generator in synchronous state machine design and in asynchronous state machine design.
- Design of a digital clock in synchronous state machine design and in asynchronous state machine design

Design of gate level circuit for generation of complement and sign-magnitude form of a given 4-bit signed number.

Design and submission of term project

Note:
1. It is mandatory to perform experiment on any one of the EDA Tools (Multisim) before the experiment is done on hardware. All experiments must be unique, design specifications should not be common in thelab

Course outcome: After the completion of this Laboratory course, the student will be able to

CO 1	Understand the practical aspects in working of discrete digital components
CO 2	Utilize the ICs of Decoder, Multiplexer, Seven segment display unit in combination circuit design
CO 3	Utilize the ICs of suitable Flip-flops in sequential circuit design
CO 4	Utilize the Programmable Logic devices in digital design
CO 5	Understand the concepts of setup time, hold time, propagation delays
CO 6	Design circuits with optimal features of Area, Power and delay
CO 7	Design and implement prototypes of complete digital systems

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ	*Term Projectand Viva-Voce	End SemesterLab Exam	Total
Weightage (%)	15%	15%	30%	40%	100%

*Term Project may be hardware implementation or on EDA (Multisim) platform
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ENGINEERING FIRST YEAR: SEMESTER-II

22EE1281	**Computational Laboratory**	**ESC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

List of Experiments

Exercise 1: Python as a tool for computation
Exercise 2: Introduction of data visualization softwares such as Power BI, Tableau, Tensorflow
Exercise 3: Introduction and familiarization with MATLAB tool
Exercise 4: MATLAB for simulink and signal processing
Exercise 5: Simulations in LTSpice
Exercise 6: Simulations in MultiSim software

Design and submission of lab project

Note: Any other trending softwares related to EE can be introduced.

Learning Resources

Textbooks

J. Michael Fitzpatrick and AkosLedeczi,*' Computer Programming with MATLAB',*
Wordpress
Hanspeter langtangen, 'Python scripting for Computational Science', Springer publications
Reference books
Misza Kalechman, *'Practical MATLAB-Basics for Engineers'*, CRC Press.
Burkhard A.Meier, 'Python GUI Programming cookbook'. PACKT publications

Web Resources

J. Michael Fitzpatrick and AkosLedeczi, *'Introduction to Programming with MATLAB'.* URL: https://www.coursera.org/learn/matlab
Dr Sudarshan Iyengar, NTEL-IIT Ropar*, 'Joy of Computing using Python'.*
URL: https://www.nptel.ac.in/courses/106106182/
https://www.mathworks.com/academia/educators.html

Course outcome After the completion of this Laboratory course, the student will be able to

CO 1	To learn the MATLAB environment, python scripting and its programming fundamentals
CO 2	Ability to write Programs using commands and functions
CO 3	Able to simulate and visualize the data of various formats
CO 4	Able to understand perform operations on applications related to different fields
CO 5	Able to perform simulation of a simple prototype design project in Electronics and communication and relevant fields

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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ENGINEERING FIRST YEAR: SEMESTER-II

22EG1281	**English-I Laboratory**	**HSC**	**0L : 1T : 3P**	**2.5 credits**

Course objectives:

- To facilitate computer-aided multi-media instruction enabling individualized and independent language learning
- To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm
- To provide opportunities for practice in using English in day to day situations
- To improve the fluency in spoken English and neutralize mother tongue influence
- To train students to use language appropriately for debate, group discussion and public speaking

Course Content:

UNIT-I: (06 Contact Hours)
Theory: An Ideal Family by Katherine Mansfield
Spoken Skills: Situational Dialogues – Role-play – Expressions in various situations – Self Introduction – Introducing others – Greetings – Apologies – Requests – Giving directions

UNIT-II: (06 Contact Hours)
Theory: Energy -Alternative sources of Energy
Panel Debate on "On-grid & off-grid support to public participation in the production of solar energy in India", Reading the Wikipedia content on "The Green New Deal". Reflective session on the prospects of "The Green New Deal in India"
Writing Skills: Letter Writing (Formal & Informal) and Hands on Session on Letter Writing

UNIT-III: (06 Contact Hours)
Theory: Transport - Problems & solutions
Group Discussion on "The Future of Bullet Trains in India"
PPT on "The Dedicated Freight Corridors & the Future of Indian Economy" – Introduction to Speech
Spoken Skills: Sounds – Vowels, Consonants and Diphthongs – Pronunciation Exercises (Basic Level)

UNIT-IV: (06 Contact Hours)
Theory: Technology - Evaluating technology
PPT on "3R: Reduce, Recycle, Reuse" - Solo Debate on "Can Block Chain Technology Mitigate the Issue of Cyber Crimes and Hacking?"
Presentation Skills: JAM –Description of Pictures, Photographs, Process, Talking about wishes, Information Transfer

UNIT-V: (06 Contact Hours)
Theory: Environment - Ecology versus Development
Listening Skills: Listening Activity on YouTube video on "Greening the Deserts" - Students' seminar on "Waste to Wealth: Examples from around the Globe".

UNIT-VI: (06 Contact Hours)
Theory: Industry - Selling products
Reading Skills: Reading the material on "4Ps: Product, Price, Place, and Promotion" Role play on "How to sell your product and services"

References:
Non – Detailed Text Book: Panorama – A Course on Reading published by Oxford University Press, India
English for engineers and technologists by Orient Black Swan
A Textbook of English Phonetics for Indian Students 2nd Ed T. Balasubramanian. (Macmillan), 2012.
Speaking English Effectively, 2nd Edition Krishna Mohan & NP Singh, 2011. (Macmillan).
A Hand book for English Laboratories, E.Suresh Kumar, P.Sreehari, Foundation Books,2011
English Pronunciation in Use. Intermediate & Advanced, Hancock, M. 2009. CUP
Basics of Communication in English, Soundararaj, Francis. 2012.. *New Delhi: Macmillan*
English Pronouncing Dictionary, Daniel Jones Current Edition with CD.Cambridge, 17th edition, 2011.

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

CO 1	Understand the issues affecting the economy and environment in India and across the globe
CO 2	Develop the instinct for problem solution
CO 3	Develop the ability to collect materials on various socio-economic- technological issues and prepare PPT for presentation
CO 4	Improving listening skills
CO 5	Inculcate speaking as a behaviour by repeated practice and exposure

Course Nature: THEORY + LABORATORY

Internal Assessment (40 Marks)	**External Assessment (**60 Marks)
Record Writing– 10 Marks	Reading Comprehension 15 Marks
Attendance – 10 Marks	Writing30 Marks

Continuous Assessment (Listening – 10 Marks + Oral Presentations – 10 Marks)	Speaking (Viva-Voce) 15 Marks

ENGINEERING FIRST YEAR: SEMESTER-II

22EC1201	**Electronic Devices & Circuits**	**ESC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objectives

- To make the students understand the fundamentals of Electronic Devices and Circuits.
- To design simple Electronic circuits understanding the concept of design specification and design requirements.

Course Content

Unit-I **(6 hours)**

Introduction

Intrinsic and Extrinsic semiconductors, Fermi Level in Intrinsic and Extrinsic semiconductors. Mobility and conductivity, Diffusion currents and drift currents, Injected minority carrier charge, contact potential, currents in forward and reverse biased junction.

Unit-II **(10 hours)**

Diodes

The open circuited p-n Junction, Current components in a p-n diode, Volt-Ampere characteristics (Forward Bias and Reverse Bias and temperature dependence of the V/I characteristic, Diode Resistance (Static and Dynamic), Diode as a circuit element ,diode models, Load line concept, Small signal analysis of diode, Transition capacitance and Diffusion capacitance, Junction diode switching times; Zener diodes, Zener breakdown and Avalanche breakdown, Zener voltage regulator and its limitations.

Unit-III **(10 hours)**

PN Diode Applications

Half Wave, Full wave and Bridge rectifiers (their operation, performance calculations), with Filters (RC, LC, RLC), Ripple factor calculations, Clippers (two level) Transfer characteristics, clampers; Diode as a switch; Diode as a analog gate, Voltage Multipliers (Doubler and Tripler).

Unit-IV **(18 hours)**

MOSFETs

MOS capacitor, MOSFET construction, Types of MOSFET (Enhancement type and Depletion type), derivation of current equation, Regions of operation, second order effects (Channel-length modulation, body effect), MOSFET characteristics and operating point including load line analysis, MOSFET as a switch (inverter). Biasing of a MOSFET.

Unit-V **(8 hours)**

BJT Characteristics

BJT construction, Transistor Junction formation (Collector-Base, Base-Emitter Junctions), Current components; Modes of Transistor operations; Early Effect, BJT input and output characteristics in

different configurations, BJT as an inverter.

Unit-VI **(8 hours)**

Transistor Biasing and Stabilization-BJT

Biasing techniques-different types of biasing , Transistor as an amplifier, Thermal runaway, heat sinks, Thermal stabilization, Operating point stabilization against temperature and device variations, Stability factors, Bias stabilization and compensation techniques.

Learning resources

Text book

Jacob Milliman, Christos C. Halkias, and Satyabratajit, *'Electronic Devices and Circuits'* McGraw Hill, 3rd Edition,2012.

David A.Bell, *'Electronic Devices and Circuits'*, Oxford University Press, 5th edition, 2008.

Reference Books

Ben G.StreetMan, Sanjay Kumar Benerjee, *'Solid State Electronic Devices'*,6th edition.

Web Resources

Prof K Radhakrishna Rao, NPTEL-IIT Madras, *'Electronics for Analog Signal Processing-I'.* URL: https://nptel.ac.in/courses/117106087/

Dr. Mahesh B Patil, NPTEL-IIT Bombay, *'Basic Electronics'.*
URL: https://nptel.ac.in/courses/108101091/

Dr. Chitralekha Mahanta,NPTEL - IIT Guwahati, *'Basic Electronics',*
URL: https://nptel.ac.in/courses/117103063/

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

CO 1	Apply the knowledge of basic semiconductor physics and understand the working principles
CO 2	Analyze the characteristics of various electronic devices like diodes, transistor etc
CO 3	Classify and analyze the various circuit configurations of transistor and MOSFETs
CO 4	Designing circuits for different applications using diodes
CO 5	Analyze the concept of stability and biasing of transistors
CO 6	Troubleshooting circuits which utilizes diodes, transistors

Assessment Method

Assessment Tool	Weekly tests/Assignments (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

ENGINEERING FIRST YEAR: SEMESTER-II

22EC1281	**Electronic Devices & Circuits Lab**	**ESC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

To get a hands-on experience on the concepts present in Basic Electronics Theory course and thereby developing practical knowledge in analysis of electronic circuits using Diodes, BJTs and MOSFETs

List of Experiments

1. Introduction to Lab Components and Electronic instruments.
2. Soldering/De-soldering of components on PCB.
3. Characteristics of PN junction Diode, Zener Diode.
4. Characteristics of LED, Photodiode.
5. Design of voltage regulators using Zener Diodes.
6. Design of Half wave Rectifier, Full wave, Bridge wave rectifier with and without LC, RC filters.
7. Design and analysis of Clippers and Clampers.
8. Design and analysis of Voltage Multipliers.
9. Design and analysis of analog gate and digital gates.
10. Transfer characteristics of MOSFETs.
11. Characteristics of Common Base, Common Emitter, Common collector configurations of BJTs.`1
12. Stability analysis and biasing of BJT Circuits.
13. Design and submission of lab project

Note: It is mandatory to perform experiment on any one of the EDA Tools before the experiment is performed on hardware. All experiments must be unique, design specifications should not be common in the lab.

Course outcome:

After the completion of this Laboratory course, the student will be able to

CO 1	Experimental verification of transfer characteristics of diodes and transistors
CO 2	Design voltage regulators using diodes
CO 3	Design multilevel clippers and clampers using diodes
CO 4	Design and troubleshooting circuits which utilizes diodes
CO 5	Experimental analysis of different configurations of transistor circuits
CO 6	Design of BJT circuits considering stability and biasing practically
CO 7	Implementing and analysing a practical prototype of Diode/BJT application

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ	*Term Project and Viva-Voce	End Semester Lab Exam	Total
Weightage (%)	15%	15%	30%	40%	100%

*Term Project may be performed either on hardware or on any EDA tool (LT spice preferred) platform.

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ENGINEERING FIRST YEAR: SEMESTER-II

22EE1201	**Network Theory**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objective

- To make the students capable of analyzing any given electrical network
- To equip students with network analysis tools like two port networks, Laplace transformations, and transient analysis.

Course Content

Unit- I **(10 hours)**

Basic concepts of Networks

Ohm's Laws and Kirchhoff's Laws, Open circuit and Short circuit, Current and Voltage division rule, Network Reduction Techniques – Series, Parallel, Series Parallel, Star–to-Delta or Delta-to-Star Transformations, Nodal Analysis and Mesh Analysis. Network theorem and applications. (Both Independent & Dependent sources).

Unit- II **(10 hours)**

Transient analysis of First order Circuits

Initial conditions (analysis & Problems) Natural and forced response of RL , RC Circuits, Transient analysis with different Excitations viz Step, Impulse and Sinusoidal.

Unit-III **(10 hours)**

Transient analysis of Second order Circuits

Initial conditions (analysis & Problems) Natural and forced response of RLC Circuits, Transient analysis with different Excitations viz Step and Sinusoidal.

Unit- IV **(10 hours)**

Circuit Analysis Using Laplace Transform

Introduction to Laplace transform, Circuit element models, Circuit Analysis using Laplace-examples, Transfer functions, Solution of circuit differential equations using Laplace transforms.

Unit-V **(12 hours)**

Two Port Network parameters.

Relationship of two port variables, Open circuit Impedance parameters, Short circuit Admittance parameters, Transmission Parameters, Hybrid Parameters, Relationship between parameter sets, Reciprocity and Symmetry, Interconnection of two port networks, Reciprocity Theorem.

Unit- VI **(8 hours)**

State Space Models For Electrical Networks

Concept of state, State equations, Equivalent source method, State space model and evaluation of state transition matrix, Application to electrical networks.

Learning Resources

Text Books

Charles K Alexander, Matthew N O Sadiku, '*Fundamentals of Electric Circuits*', Mc Graw Hill – 5th edition.

William H. Hayt, Jack Kemmerly, Steven M. Durbin, '*Engineering Circuit Analysis'*, Tata Mcgraw – Hill, 8th edition.

Reference Books

Valkenburg M.E. Van, *'Network Analysis*' , Prentice Hall.

N. C Jagan, CLakshmi Narayana, *'Network Theory'*, BS Publications

Web Resources

Prof S.C Dutta Roy NPTEL-IIT DELHI, '*Circuit Theory'*
URL: https://nptel.ac.in/courses/108102042/

Prof T K Basu, NPTEL-IIT Kharagpur, *'Networks, Signals and Systems*'
URL: http://nptel.ac.in/courses/108105065/

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

CO 1	Analyze the electric circuits using network theorems
CO 2	Deduce transient response for circuits
CO 3	Apply Laplace transformations for solving electric circuits problems
CO 4	Apply graph theory to obtain network theory solutions
CO 5	Analyze electric circuits using two port networks and relevant theorems
CO 6	Apply state space models for electric circuits

Assessment Method

Assessment Tool	Weekly tests/Assignments (in a semester)	Monthly tests (in a semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING FIRST YEAR: SEMESTER-II

22EE1202	**Introduction to AI**	**BSC**	**2L: 0T: 0P**	**1 credits**

Course Learning Objective

Course Content

Unit-I: Introduction to AI, part-1
Concept of AI, history, current status, scope, agents, environments, Problem Formulations
Unit-II: Introduction to AI, part-2
Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search.
Unit-III: Introduction to ML, part-1
Basics of Linear Regression, Logistic regression,
Unit-IV: Introduction to ML, part-2
Introduction to Support Vector Machine, Principal component analysis.
Unit-V: Artificial neural networks
Multilayer Neural network, neural network and back propagation algorithm, deep neural network
Unit-VI: Python Exercises
Python exercise on neural network, PCA and random search algorithm.

Learning Resources
Textbooks
Peter Norvig and Stuart Russel, Artificial Intelligence- A Modern Approach (3rd edition)
Deepak Khemani, A First Course in Artificial Intelligence

Reference books
Burkhard A.Meier, 'Python GUI Programming cookbook'. PACKT publications
Andreas C. Müller, Sarah Guido, Introduction to Machine Learning with Python
Web Resources
https://in.coursera.org/specializations/machine-learning-introduction
Course outcome: After the completion of this course, the student will be able to

CO 1	Understand the scope of AI and ML in real-time applications

CO2	Understand the various available algorithms in AI and ML so as to get updated with the current technology trends

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weight age (%)	10%	30%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-I

22MA2101	**Probability and Random variables**	**BSC**	**3L: 1T: 0P**	**3 credits**

Course objective:

- To provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in signal processing and Communication Engineering
- To introduce students to the basic methodology of "probabilistic thinking" and to apply it to problems.
- To understand basic concepts of probability theory and random variables, how to deal with multiple random variables, Conditional probability and conditional expectation, joint distribution and independence, mean square estimation.
- To understand the difference between time averages and statistical averages.
- Analysis of random process and application to the signal processing in the communication system.
- To teach students how to apply sums and integrals to compute probabilities, means and expectations.

Course Content

Unit - I **(08 hours)**

Permutations and Combinations, Probability introduction through Sets and Relative Frequency, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem and Independent Events.

Unit - II **(07 hours)**

Definition of random variable, discrete and continuous random variables, independent random variables. Distribution function and its properties, probability mass function, probability density function and their properties. Expectation of a random variable and its properties. Variance of a random variable and its properties. Definition of bivariate random variable, discrete and continuous bivariate random variables, distribution function of a bivariate random variable, joint probability mass function, joint probability density function, marginal probability mass function, marginal probability density function, conditional probability mass function and conditional probability density function.

Unit-III **(10 hours)**

Discrete distributions: Bernoulli, Binomial, Poisson, Negative Binomial, Geometric and hyper geometric distributions (Find their mean, variance and problems). Continuous distributions: Uniform, Exponential, Normal, Beta and Gamma distributions. Covariance, Correlation coefficient (Karl Pearson), Functions of Random variables**.**

Unit –IV **(05 hours)**

Linear regression and Curve fitting: Fitting a straight line and parabola.

Unit – V **(07 hours)**

Markov's inequality, Chebyshev's inequality and Cauchy-Schwartz's inequality (with proofs). Generating functions: Moment generating function (M.G.F) and its properties, characteristic functions (C.F) and its properties, Cumulant generating function (C.G.F) and its properties, probability generating function (P.G.F) and its properties.

Unit – VI **(08 hours)**

Order statistics, Sequence of Random Variables, Convergence of a Sequence of Random Variables, Convergence Theorems: WLLN (weak law of large numbers), SLLN (strong law of large numbers) and Central limit theorem.

Learning resources

Text book

Peyton Z. Peebles, '*Probability, Random Variables & Random Signal Principles'*, TMH, 4th Edition, 2001.

Reference Books

George R. Cooper, Clave D. MC Gillem, '*Probability Methods of Signal and System Analysis',* Oxford,3 Edition,1999.

S.P. Eugene Xavier, '*Statistical Theory of Communication'*, New Age Publications, 1997.

Athanasios Papoulis and S. Unnikrishna Pillai', *Probability, Random Variables and Stochastic Processes*', TMH, 4th Edition.

Web resources:

Prof M. Chakraborty, NPTEL-IIT Kharagpur, *'Probability and Random Variables'*. URL: https://nptel.ac.in/courses/117105085/

Prof M Dharmaraja, NPTEL-IIT Delhi, *'Introduction to Probability Theory and Stochastic Process'*. URL: https://nptel.ac.in/courses/111102111

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

CO 1	Apply Simple probabilities using an appropriate sample space.
CO 2	Apply Simple probabilities and expectations from probability density functions.
CO 3	Apply problem-solving techniques to solving real-world events.
CO 4	Apply selected probability distributions to solve problems.
CO 5	Apply Mean and covariance functions for simple random processes.
CO 6	Interpret and clearly present output from statistical analysis.

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weight age (%)	10%	30%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-I

22EE2182	**Internet of Things Lab**	**ESC**	**0L: 0T: 3P**	**1 Credits**

Course Learning Objectives

- To assess the vision and introduction of IoT.
- To understand IoT Market perspective.
- To implement Data and Knowledge Management and use of Devices in IoT Technology
- To indulge in designing of prototype hardware for different IoT application

Course Content

Exercise – I
Introduction & Overview of Internet of things
The Internet of things today and tomorrow, IoT architecture outline , Functional blocks of IOT , industrial IOT, IOT enabled Smart devices in market, Application areas for IOT, Challenges in IOT. Hardware and Software tools required for IOT application development, Overview of IOT based on Particle Hardware platforms and IDE's for development.

Exercise - II
Exploring the arduino board and its software IDE
The Arduino board, The command area, text area and message window area. Setup function, Controlling the hardware, loop functionality, verifying your sketch, uploading and running your sketch and finally modifying your sketch according to your requirement.

Exercise - III
Introduction to sensors and displays
Interfacing sensors to Arduino boards about the sensor, the circuit connections, sketch (software program), Application.And interfacing displays to arduino board

Exercise - IV
Communication
Wireless communication, introduction to Bluetooth module, interfacing to Arduino in both one way communication and two way communication, controlling an LED in wireless mode, interfacing wifi module with arduino controlling things by using local network.
Exercise - V
Introduction to NodeMCU (ESP32 Wi-Fi SoC)
Controlling the things with Nodemcu using wifi communication in both ways and interfacing nodemcu with various peripheral devices. Compare Esp8266 with other arduino boards

Exercise – VI
Introduction to Cloud platforms

IOT device to cloud storage communication Model, need of Cloud services in IOT, different Cloud storage services available today, Cloud Data processing and frame format, Role of Smart phones in IOT, Examples on Home automation and Smart city development, Introduction to clouds like Temboo, Blynk, Pubnub etc.

Exercise -VII

Introduction to GSM, GPS Module

Interfacing Arduino (uno) with Gsm, Module 2G communication and interfacing GPS module for tracking location.

Exercise –VIII

Interfacing to External devices

Interfacing Arduino with External storage, Ex: SD card (reading,writing)Handling Interrupts and memory management and Ethernet communication.

Exercise –IX

Introduction to Rasberry pi

Features, Comparison with Arduino, Hardware details and Programming.

Exercise –X

App Inventor

Create apps with coding, Designing apps and interfacing with Arduino.

Exercise –XI

Any one of the project from the list below

Project -I

Home Automation with blue tooth and wifi and controlling the things with Mobile Apps
Designing water level controller.

Project -II

Designing women safety system with GPS and GSM module
Designing secured car parking system using GPS and GSM module

Project -III

Uploading sensor information to cloud, operating and Monitoring
Designing Smart Hospital with IoT devices.

Design and submission of lab project

Learning resources

Text Books:

Cuno Pfister, ‘Getting started with the Internet of Things: Connecting sensors and Microcontrollers to the Cloud’, O’Reilly Media Inc. Publications
Daniel Kellmereit, Daniel Obodovski, ‘The Silent Intelligence: The Internet of Things’, DND Ventures LLC Publications

Reference Books:

Pethuru Raj and Anupama C. Raman, '*The Internet of Things: Enabling Technologies, Platforms and use cases'*, CRC Press

Arshdeep Bahga and Vijay Madisetti, '*Internet of Things: A hands-on approach*', Universities Press

Web resources:

1. Prof Sudip Misra, NPTEL-IIT Kharagpur, *'Introduction to Internet of Things'*
   URL: https://nptel.ac.in/courses/106105166/

Course outcomes: At the end of the course, the student will

CO1	Understand and analyze concepts of Internet of Things
CO2	Familiar with arduino board and its software
CO3	Interfacing sensors with arduino board and its working
CO4	Analyze basic protocols in wireless sensor network
CO5	Understand NodeMCU arduino board for global communication
CO6	Understand cloud platform to operate our devices through controller
CO7	Design IoT applications in different domain and be able to analyze their performance

Assessment Method:

Assessment Tool	(Internal Exam) Hardware Project submission	End Semester Lab Examination	Total
Weightage (%)	40%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-I

22EC2101	**Analog Electronic Circuits**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objective

To make the students understand the concept of amplifier designs using BJTs and MOSFETs and comparison between similar designs

Course content

Unit-I **(10 hours)**

BJT- Differential amplifiers and Current mirrors

Design of various configurations BJT (CE,CB and CC) amplifiers using current mirrors. Design of a differential amplifier with BJT using active load using current mirrors. Design of Single stage and two stage opamp.

Unit-II **(8 hours)**

BJT- Configurations and Multi stage amplifiers

BJT - small signal analysis, Comparison between Large signal models and small signal models. and amplification and small signal resistances in different configurations (CE,CB and CC) and multi stage amplifiers.

Unit-III **(10 hours)**

MOSFET Biasing and Its Small Signal Analysis

Regions of operation of MOSFET, Biasing, Large signal and Small signal models, Channel length modulation, Design of MOSFET amplifier in Common Source, Common Gate and Common Drain configurations. Calculating small signal resistances of different MOSFET circuits.

Unit-IV **(12 hours)**

Multi-Stage Amplifiers & Differential Amplifiers of MOSFET

Cascade Amplifiers, Millers theorem, and Cascode amplifiers, Frequency Analysis of Multi Stage Amplifiers, Calculation of lower & higher cutoff frequencies.

Operation of Differential Amplifier, Transfer characteristics of Differential amplifier, Biasing of Differential amplifiers, MOSFET differential amplifiers using resistive loads, Calculations of Differential gain, Common mode gain and CMRR. Step response of a Differential amplifier.

Unit-V **(8 hours)**

Current mirrors in MOSFETs

Design of various configurations MOSFET (CS,CG,CD) amplifiers using current mirrors. Design of a differential amplifier with MOSFET using active load using current mirrors. Design of Single stage and two stage opamp.

Unit-VI

CMOS circuits **(12 hours)**

NMOS and PMOS inverter, NMOS inverter using active load; CMOS inverter, Pull up network and Pull down network (PUN and PDN), logic gates using CMOS, static power and dynamic power, noise margin. Pass Transistor Logic, Transmission gates. Bistability principle, Latches, Flip flops.

Learning Resources

Textbooks

Behzad Razavi, '*Fundamentals of Microelectronics',* Wiley Publications

Sedra and Smith, *'Microelectronics Circuits',* Oxford Publications,6th Edition.

Reference Books

Boylestad R. L. and L. Nashelsky, *'Electronic Devices and Circuit Theory'*, 10/e or 11/e, Pearson, 2009.

Millman J. and C. Halkias, *'Integrated Electronics'*, 2/e, TMH, 2010.

Neamen D., *'Electronic Circuit Analysis and Design'*, 3/e, TMH, 2006

Spencer R. R. and M. S. Ghausi, *'Introduction to Electronic Circuit Design'*, Pearson, 2003

Web Resources

Prof.K.Radhakrishna Rao, NPTEL-IIT Madras, *'Electronics for Analog signal processing - I'*, URL: http://nptel.ac.in/courses/117106087/

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

CO 1	Understand the small-signal analysis and large-signal model for BJT circuits
CO 2	Design of BJT and MOSFET amplifiers in different configurations
CO 3	Design and analyze of multi-stage amplifiers
CO 4	Design and analyze differential amplifiers with active and passive loads
CO 5	Design and analyze feedback amplifiers in different configurations
CO 6	Use these engineering abstractions to analyze and design simple electronic circuits using EDA tools

Assessment Method

Assessment Tool	Weekly tests (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-I

22EC2181	**Analog Electronic Circuits Laboratory**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

To make understand the concept of single stage and multistage amplifier design using BJTs and MOSFETs

List of Experiments

1. Characterization of MOSFET.
2. Design and Analysis of Single stage amplifier using MOSFETs
    a. i.Common Source configuration.
    b. ii.Common Gate configuration.
3. iii.Common drain configuration.
4. Design and Analysis of Multi Stage Amplifier using MOSFETs
    a. i.Cascade Amplifier.
    b. i.Cascode Amplifier.
5. Design of amplifiers using Current mirrors.
6. Design and analysis of Single stage amplifier using BJTs
    a. i.Common Emitter Configuration.
7. ii.Common Collector Configuration.
8. iii.Common Base Configuration.
9. Differential amplifiers with passive load (Designing a specified value
    a. of CMRR).
10. Step response of a differential amplifier and designing for a rise time.
11. Single tuned amplifier design.
12. Design of Class-B power amplifier.
13. Design, build and test Public addressing system.
14. Design and submission of lab project

Note: It is mandatory to perform experiment on any one of the EDA Tools (LT spice tool) before the experiment is done on hardware. All experiments must be unique, design specifications should not be common in the lab

Course outcome

After the completion of this Laboratory course, the student will be able to

CO 1	Determine the characteristics BJT amplifiers in CE,CB,CC configurations
CO 2	Determine the characteristics of MOSFET amplifiers in CS,CG,CD configurations
CO 3	Determine the characteristics of Cascade and Cascode amplfiers

CO 4	Designing feedback amplifiers with different configurations
CO 5	Design of differential amplifiers with active and passive loads
CO 6	Design and testing of public addressing system
CO 7	Design of a simple electronic circuit which uses multistage amplifiers

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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ENGINEERING SECOND YEAR: SEMESTER-I

22CS1209	**Object Oriented Programming**	**ESC**	**3L: 1T: 0P**	**3 credits**

Course Learning Objectives

- Gain knowledge about basic C++ language syntax and semantics to write C++ programs and use concepts such as variables, conditional and iterative execution methods etc.,
- Understanding the fundamentals of object-oriented programming inC++, including defining classes, objects, invoking methods etc. and exception handling mechanisms.
- Understand the principles of inheritance, packages andinterfaces.
- Understand the principles of Multithreading and Appletprogramming
- Course content

Unit-1: Review of C: strings, arrays, pointers, Programming in C++ : Build and execute a C program in C++, Write equivalent programs in C++, C++ as Better C : Procedural Extensions of C

Unit-2: OOP in C++: Classes and basic Object-Oriented features (encapsulation), Overview of OOP in C++: More OO features, overloading, namespace and using struct and union

Unit-3: Inheritance : Generalization / Specialization of Object Modeling in C++, Polymorphism : Static and Dynamic Binding.

Unit-4: Type Casting &Exceptions : C++ cast operators; C++ Exceptions & standard exception

Unit-5: Classes Templates& STL - Function and Class templates and using STL like containers, algorithms.
Unit-6: File handling, streams, Interfaces and Multithreaded Programming. References:
C++ Primer, Stanley Lippman, 5th edition.
Object-Oriented Programming with C++, E.Balagurusamy, McGraw-Hill Education (India)

Web resources:
1. PROF. PARTHA PRATIM DAS, IIT Kharagpur, NPTEL," PROGRAMMING IN C++" NPTEL :: Computer Science and Engineering - NOC:Programming in C++
Object Oriented Programming in C++ - GeeksforGeeks

ENGINEERING SECOND YEAR: SEMESTER-I

22CS1289	**Object Oriented Programming Laboratory**	**ESC**	**0L: 0T: 3P**	**1 credits**

Course Learning Objective

- To build software development skills using C++ programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, arraylist, User defined Linked List, File Handling, exception handling andMulti-threading.

List of Experiments

Lab No 1: Basic Programs in C++.
Lab No 2: Programming Assignments on Arrays and Strings.
Lab No 3: Programming Assignments on Classes, Objects and Encapsulation. Lab No 4: Implementing the concepts of Inheritance and Array Objects.
Lab No 5: Implementing the OOPS Concepts of Abstract, Interfaces and Polymorphism. Lab No 6: Programming Assignments on File Handling.
Lab No 7: Programming Exercises on Exception Handling. Lab No 8: Working with List Operations.
Lab No 9: Implementing the concepts of Multi-Threading.
Design and submission of lab project

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

CO 1	Understanding the control structures and conditional statements in C++
CO 2	Understanding the arrays and String handling in C++
CO 3	Understanding the difference between class and object and providing security for objects
CO 4	Understanding the reusability of objects and working with multiple objects
CO 5	Understanding about hiding the data, getting multiple inheritance through Interfaces
CO 6	Understanding the data processing from files
CO 7	Understanding about handling run time abnormal program executions
CO 8	Understanding about creating user defined linked list and dynamic objects
CO 9	Understanding the multi-threaded programming and inter thread Communication

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab Project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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ENGINEERING SECOND YEAR: SEMESTER-I

22ECXXXX	**Signals and Systems**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objectives

- To understand the fundamental characteristics of signal and systems.
- To understand signal and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspective provide.
- To develop mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course content:

Unit - I **(10 hours)**

Mathematical representations of a signal, Common signals in Engineering: Exponential and Sinusoidal signals, singularity functions- unit impulse function, unit step function , Transformations of the independent & dependent variables, size of a signal, absolutely integrable & square integrable functions, Characterization & Classification of Signals, Modeling of systems: input-output description, typical examples of systems, Characterization, Classification and properties of systems, Interconnections of systems

Unit - II **(10 hours)**

System Response to Internal Conditions, The representation of CT signals in terms of impulses, the CT unit impulse response, system response to external input: convolution for CT LTI systems, Properties of Convolution, Properties of CT LTI systems: memoryless systems, stability, invertibility, causality; unit step response, Differential equation models & Solution of differential equations: Natural & Forced responses, ZIR & ZSR, stability in terms of natural response, System response to complex exponential inputs

Unit- III **(12 hours)**

Signals and Vectors, Signal comparison: correlation, Signal representation by orthogonal signal set, Trigonometric Fourier series, Wave Symmetry, exponential Fourier series, Convergence of the Fourier series and Gibbs Phenomenon, frequency spectra, Properties of Fourier series, Power representation using Fourier series, LTI system response to periodic inputs.

Unit- IV **(10 hours)**

Development of CTFT of an aperiodic signal, Convergence of CTFT, CTFT of some useful functions, Magnitude and Phase representation of CTFT, The CTFT of periodic signals, Properties of CTFT, Frequency spectra of signals, Signal bandwidth, System bandwidth, Frequency response of LTI systems, Energy and Power Density Spectra.

Unit-V **(12 hours)**

The Laplace Transform, Region of Convergence, Laplace transform of elementary functions,

Properties of Laplace Transform, The Inverse Laplace Transform, Response of LTI systems, System Functions, Relationship between Laplace Transform and Fourier Transform, Solution of differential and Integro-Differential Equations

Unit-VI **(6 hours)**

Periodic sampling, Sampling theorem, Pre filtering to avoid aliasing, Frequency domain representation of sampling, Reconstruction of a band limited signal from its samples**,** Sampling of band pass signals**.**

Learning Resources

Text Books

Alan V Oppenheim, Alan V Willsky, S. Hamid Nawab, '*Signals and Systems*', 2nd edition, Pearson/PHI, 2015

B P Lathi, '*Principles of Signal Processing and Linear Systems*', 1st edition, Oxford University press, 2009

Reference Books

Simon Haykin, Van Veen, '*Signals & Systems*', 2nd Edition, Wiley Publications, 2007.

Mahamood Nahvi, '*Signals and Systems*', McGraw Hill Publishers, 1st edition, 2015.

Web Resources

Prof. Alan V. Oppenheim, Massachusetts Institute of Technology (MIT), '*Signals and System*'. URL: https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/

Prof. K S venkatesh, NPTEL-IIT Kanpur, '*Signals and Systems*'.
URL: http://nptel.ac.in/courses/117104074/

Prof. V.G.K. Murti, NPTEL-IIT Madras, '*Networks and Systems*'.
URL: http://nptel.ac.in/courses/108106075/

Course outcomes

At the end of the course, the student will be able to

CO 1	Analyze the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier analysis.
CO 2	Classify systems based on their properties and determine the response of LSI system using convolution.
CO 3	Analyze system properties based on impulse response and Fourier analysis.
CO 4	Apply the Laplace transform for analyze continuous-time and discrete-time signals and systems.
CO 5	Understand the process of sampling and the effects of under sampling.

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electrical & Electronics Engineering

ENGINEERING SECOND YEAR: SEMESTER-I

22EE2101	**Electrical Machines**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objectives:

- To make understand the concept of AC rotating machines.
- To make understand the concept of the Induction motor
- To understand the concept of synchronous generator and motor
- To get knowledge about applications of induction and synchronous machines

Unit-I: **(10Hrs)**

DC machines: DC generators, commutation, methods of excitation, characteristics of DC generators and motors, starting and speed control of DC motors.

Unit-II: **(10Hrs)**

Transformers:Review of single-phase transformer, Polarity test, Sumpner's test, auto transformer. three phase transformers- Connections - Δ-Δ, Y-Y, Δ-Y, Y-Δ, V-V – vector groupings Yy0, Dd0, Yd1, Yd11, Dy1, Dy11, Scott connection – three winding transformer – tertiary winding.

Unit-III: **(10Hrs)**

Induction machines: construction, flux and MMF waves, equivalent circuit, speed-torque characteristics and testing- No Load and Blocked Rotor Tests, cogging and crawling, induction generators.

Unit-IV: **(10Hrs)**

Starting Methods and Starting Current and Torque Calculations Speed Control-Change of Frequency; Pole Changing and Methods of Consequent Poles; Cascade Connection. Single Phase Induction Motors: Single phase induction motor – Constructional features - Double revolving field theory – Elementary idea of cross-field theory – split-phase motors – starting methods of single-phase induction motors.

Unit-V: **(10 Hrs)**

Synchronous machines: basic synchronous machine model, synchronous reactance, armature reaction, synchronizing to infinite bus bars, operating characteristics, power flow equations.

Unit-VI: **(10 Hrs)**

Salient pole machines, parallel operation, hunting, synchronous motors, V and inverted V curves, starting of synchronous motors. The theoretical concepts will be supplemented using numerical examples.

Learning Resources:

Text Books:

I J Nagrath and D P Kothari, "Electric Machines", McGraw Hill Education, Third Edition, 2004.
P S Bimbhra, "Electrical Machinery" Khanna Publishers, Seventh Edition, 2011.

Reference Books:

M G Say, "Performance and design of AC machines", CBS Publishers, Third Edition, 2002.
A E Fitzgerald and C Kingsley, "Electric Machinery", McGraw Hill Education, Seventh Edition, 2020.
J B Gupta "Theory and performance of Electrical Machines", S.K.Kataria & Sons Publishers 14th Edition, 2009.

Web resources:

Prof. P. Sasidhara Rao, NPTEL, IIT-Madras, Electrical Machines-II
https://nptel.ac.in/courses/108/106/108106072/
Prof. Tapas Kumar Bhattacharya NPTEL, IIT-Khragpur, Electrical Machines-II,
https://nptel.ac.in/courses/108/105/108105131/

Course Outcomes:

At the end of the course the student will be able to

CO 1	Understand Induction motor operation, construction, and applications
CO 2	Understand the starting and speed control techniques for induction motors
CO 3	Understand Synchronous generator operation, construction, and applications
CO 4	Analyze the parallel operation of alternators
CO 5	Understand the principle of operation of Synchronous motor
CO 6	Understand the applications and starting methods of Synchronous motor

ENGINEERING SECOND YEAR: SEMESTER-I

22EE2181	**Electrical Machines Lab**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objectives:

- To make understand the concept of Induction motors in real-time
- To make understand the concept of the speed control of the Induction motor
- To understand the concept of voltage regulation of Alternator in real-time
- To get knowledge about the operation of Synchronous and induction machines
- To get familiar with AC electrical Machines

List of Experiments:

1. Torque-speed characteristics of squirrel cage Induction Motor
2. Speed Control of wound rotor Induction motor using rotor resistance control
3. Parameter estimation of squirrel cage Induction motor using Blocked rotor & No-load test
4. Determination of voltage regulation of Synchronous generators using EMF & MMF method.
5. V and inverted V curves of Synchronous motor.
6. V and inverted V curves of synchronous generators.
7. Speed Control of Induction motor using rotor using V/f control method
8. Determination of voltage regulation of Synchronous generators using ASA method.
9. Equivalent circuit diagram of 1-phase Induction motor
10. Parallel operation of Alternators
11. Sumpner's test on two single phase transformers
12. Scott connection of single phase transformers
13. Determination of OCC & Load characteristics of D.C. generators
14. Swinburne's Test on DC Machine
15. Brake test on D.C. Shunt motor
16. Design and submission of lab project

Note: Instructors should cover at least 9 experiments from the above list. Apart from this, instructors can choose more experiments if time permits.

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

CO 1	Analyze Torque-speed characteristics of induction motor
CO 2	Analyze no-load, blocked rotor, and speed control of induction motor
CO 3	Analyze the voltage regulation of Alternators
CO 4	Analyze the Parallel operation of Alternators
CO 5	Understand the principle of operation of AC machines
CO 6	Understand the Phasor and equivalent circuit diagrams of induction motor and Alternators

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab Project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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ENGINEERING SECOND YEAR: SEMESTER-II

22EE2281	**Robotics Laboratory**	**ESC**	**0L: 0T: 3P**	**1 credits**

Course Learning Objectives:

- To differentiate different types of robots.
- To analyze the components of robots, sensors, actuators.
- To be exposed to coordinate transformations, I/O logic, wireless and wired communication.
- To explore the applications of Arduino and Raspberry pi for Robotics
- To get familiarization with aerial robotics: Drones

Course Content:

Exercise- I
Introduction to Robotics
What is robot and robotics, already designed robots, Manual and Autonomous robots, Different types of industrial arm robots, and arm design, Coordinate transformations for more motor moments, Electrical connections of different boards and modules: How to connect closed circuit, digital and analog pins connections.

Exercise-II
Logic design, Actuators and sensors
Logic and binary math conversions: OR, AND, XOR, XNOR gates, binary and hexadecimal conversions, Introduction to Arduino, Actuators, Sensors, Wired and wireless communication, I/O communication through USB cable, Bluetooth HC05, RF modules, DTMF module, Xbee modules.

Exercise-III
Basic robots and Raspberry Pi
Line follower: Line follower robot design and control with Arduino board, Obstacles avoider: Obstacle avoider robot with IR sensors and Arduino board, Mobile controller: Mobile controller robot with DTMF module and HC05 module, Introduction to Raspberry pi: What is raspberry and differences between Arduino and raspberry pi, Applications of robotics.

Exercise – IV
Introduction to Aerial robots and Drones

List of Experiments:

1. Introduction to Robotics: Study of different parts of a robot.
2. Study of various aspects with respect to on-board sensors, actuators, drivers and other peripherals.
3. Familiarization with 8051, 8052 micro-controller board.
4. Familiarization with Arduino Boards along with Actuator Testing.
5. Building Line Follower Robot.
6. Enhanced Line Follower Robot design using state machines and coding for state machines.
7. Introduction to Bluetooth, Wi-Fi module, DTMF and building a Mobile Controller Robot.
8. Introduction to Raspberry Pi.
9. Usage of GPIO and Raspberry Pi Camera Module on Raspberry Pi board.
10. Colour Detection and Segmentation and building colour tracking Robot.
11. Introduction to Aerial Robots (Drones, UAV etc.)
12. Introduction to Pixhawk Auto-Pilot.
13. Calibration of Drone and Flight Test.
14. Team Project.

Text Books:

John J. Craig, *'Introduction to Robotics: Mechanics and Control'*, Pearson Publications, 2005.
Siegwart R and Nour bakhsh I.R, *'Introduction to Autonomous Mobile Robots'*, Prentice Hall India, 2005.

Reference Books:

Murphy Robin R, *'Introduction to AI Robotics'*, MIT Press, 2000.
MykePredko, "Programming Robot Controllers" – McGraw-Hill, 1st edition, 2003.

Video Reference:

Prof. Khatib, Stanford University, 'Introduction to Robotics'
URL: https://see.stanford.edu/Course/CS223A

Course Outcomes:

CO1	Learners will be able to differentiate different types of robots.
CO2	Learners will be able to analyse the components of robots, sensors, actuators.
CO3	Learners will be able to explain the coordinate transformations, I/O logic, wireless and wired communication
CO4	Learners will be able to analyse the Arduino and Raspberry pi usage in robotics
CO5	Learners will be able to design and control basic two-wheel robot model

Assessment Criteria:

Assessment Tool	(Internal Exam) Hardware Project submission	End Semester Lab Examination	Total
Weightage (%)	40%	60%	100%

ENGINEERING SECOND YEAR: SEMESTER-II

22EE2201	Power Systems-I	PCC	3L: 1T: 0P	4 credits

Course Learning Objectives

- To understand the different types of Conventional power generating stations.
- To understand different Non-Conventional Energy sources
- To understand and concepts of the economics of generation
- To evaluate the transmission line parameters calculations
- To understand the performance of different types of Transmission lines.
- To understand the concept of underground cables and distribution systems

UNIT-I Conventional power generation (08 hours)
Structure of power system: Generation, Transmission and distribution systems; Conventional sources of electric energy, Thermal, Gas power plant model, power generation, hydropower generation, Nuclear power generation.

UNIT-II Non conventional power generation (10 hours)
Non-conventional sources of electric energy, Wind energy conversion: introduction, types of wind turbines, wind generation and control. Solar energy: Solar photovoltaic cells and generation. Block diagram models of wind and solar energy generation systems.

UNIT-III Economics of power generation (10 hours) Definitions of connected load, maximum demand, demand factor, load factor, diversity factor, and load duration curve. Baseload and peak load plants, tariff. Problems on different factors.

UNIT-IV Transmission line parameters (12 hours)
Transmission line parameters: Types of conductors, calculation of resistance of solid conductors and effect of resistance on solid conductors, calculation of inductance for single-phase and three-phase, single and double circuit lines, the concept of GMR, GMD, symmetrical and asymmetrical conductor configuration with and without transposition, Skin and Proximity effect, corona; Calculation of capacitance for 2 wire and 3 wire systems, the effect of ground on capacitance, capacitance calculations for symmetrical and asymmetrical single and three- phase, single and double circuit lines.

UNIT-V Performance of Transmission lines (12 hours)
Performance of short and medium-length transmission lines: Classification of transmission lines, short, medium, and long line and their model representations, nominal-T, nominal-Pie, and A, B, C, D constants for symmetrical and asymmetrical networks, mathematical solutions to estimate regulation and efficiency of all types of lines, Performance of long transmission lines: Long transmission line, rigorous solution, evaluation of A, B, C, D constants, representation of long lines, equivalent-T and equivalent Pie network models; Ferranti effect, charging current, effect on the

regulation of the transmission line, surge impedance and SIL of long lines, wavelength and velocity of propagation of waves.

UNIT-VI

Under Ground Cables, EHV and HVDC Transmission (8 hours)

Underground cables: Types of cables, construction, types of insulating materials, calculation of insulation resistance and stress in insulation, the capacitance of single and 3core belted cables, grading of cables, capacitance grading, numerical problems, description of inter-sheath grading, HV cables. Need of EHV transmission systems, types of DC links, comparison of AC and DC transmission, the advantage of DC transmission, HVDC systems in India.

Learning Resources:

Text Books:

C L Wadhwa, "Electric Power Systems", New age publications, New Delhi, 9th Edition, 2007.
Singh S N, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Edition, 2002.
Solanki, "Renewable Energy Technologies: Practical Guide for Beginners", PHI Learning Pvt. Ltd., 2008

Reference books:

M.V. Deshpande –Elements of Electrical Power Station Design, Third Edition, Wheeler Pub. 1998
H.Cotton& H. Barber-The Transmission and Distribution of Electrical Energy, Third Edition, Hodder Arnold;
V.K Mehta and Rohit Mehta, "Principles of Power Systems", S. Chand& Company Ltd, New Delhi, 2004.
D.Mukherjee: Fundamentals Of Renewable Energy Systems, New Age International publishers, 2007
Gilbert M. Masters: Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004.

Web resources:

Prof. D.P. Kothari, NPTEL-IIT Delhi, *'Power System Generation, Transmission and Distribution (Encapsulated from earlier Video)* URL: https://nptel.ac.in/courses/108/102/108102047/

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

CO 1	Understand the concepts of power systems.
CO 2	Understand the operation of conventional generating stations and renewable sources of electrical power.
CO 3	Determine the electrical circuit parameters of transmission lines

CO4	Understanding the performance of transmission lines
CO 5	Understand the underground cables and High Voltage transmission
CO 6	Understand the basics of Distribution systems

Assessment Criteria:

Assessment Tool	(Internal Exam) Hardware Project submission	End Semester Lab Examination	Total
Weightage (%)	40%	60%	100%

ENGINEERING SECOND YEAR: SEMESTER-II

22EE2204	**Machine Learning**	**PCC**	**3L: 1T: 0P**	**3 credits**

Course Learning Objectives

To provide a broad survey of approaches and techniques in machine learning.
To develop a deeper understanding of several major topics in machine learning.
To develop the basic skills necessary to pursue research in machine learning.

Course Content

Unit- I **(6 hours)**
Introduction, Different types of Learning, Hypothesis space and Cross-Validation, Linear Regression, Introduction to decision trees, learning decision trees, over fitting, Python exercise on decision trees and linear regression

Unit- II **(7 hours)**
K-Nearest neighbour, feature selection, feature extraction, collaborative filtering, python exercise on Knn and PCA.

Unit- III **(8 hours)**
Bayesian Learning, Naïve Bayes, Bayesian Network, Python exercise on Naïve Bayes

Unit- IV **(8 hours)**
Logistic regression, Introduction to Support Vector Machine, SVM: The Dual formation, SVM: maximum margin with noise, nonlinear SVM and Kennel function, SVM: solutions to the dual problem, Python exercise on SVM.

Unit- V **(8 hours)**
Multilayer Neural network, neural network and back propagation algorithm, deep neural network, python exercise on neural network.

Unit- VI (8 hours)
Introduction to computational learning theory, sample complexity: finite hypothesis space, VC Dimension, Introduction to Ensembles, Bagging and Boosting, Clustering, means clustering, agglomerative hierarchical clustering, python exercise on clustering.

Learning Resources:

Text Books

Tom Mitchell, '*Machine Learning*', McGraw- Hill, 1997, 1st Edition.
EthemAlpaydin, '*Introduction to Machine Learning*', Phi, 2nd Edition.

Web resources
Prof Sudeshna sarkar, NPTEL- IIT Kharagpur, '*Introduction To Machine Learning'.* URL: http://nptel.ac.in/courses/106105152/

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

1	Understand the fundamental issues and challenges of machine learning like data, model selection, and model complexity.
2	Understand strengths and weaknesses of many popular machine learning approaches.
3	Design and implement various machine learning algorithms in a range of real world applications.

Assessment Method:

Assessment Tool	Weekly tests (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-II

22EE2202	**Control Systems**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objective

- To explore the modeling of linear dynamic systems via differential equations and transfer functions utilizing state- pace and input-output representations.
- Analysis of control systems in the time and frequency domains and using transfer function and state-space methods.
- Study of the classical stability tests, such as the Routh-Hurwitz and Nyquist criterions, and design methods using root-locus plots and Bode plots.

Course content

Unit – I **(6 hours)**

Introduction-Open loop and closed loop control systems- Transfer functions- Block diagrams and their reduction - Signal flow graphs - Mason's gain formula.

Unit – II (6 hours)

Mathematical modeling and transfer functions of electrical circuits and mechanical systems. Principle and operation of Servo motors and Stepper motors.

Unit – III (8 hours)

Standard test signals, step response of first and second order systems – Time response specifications – steady state error – static error and generalized error coefficients – response with proportional, derivative and integral controllers.

Unit – IV (8 hours)

Concept – characteristic equation – location of roots in the s-plane for stability – Routh- Hurwitz criterion — Root locus – rules for the construction of root locus- construction of root locus diagram.

Unit – V (8 hours)

Introduction -Bode plots – Gain margin and Phase margin - Polar plots - Nyquist stability criterion – Need for compensators - Lag and lead compensators in frequency domain.

Unit-VI (9 hours)

Concepts of state, state variables and state model, derivation of State models from block diagrams,Diagonalization ,Solving the Time invariant state Equation, state transition Matrix and it' s Properties ,Concepts of Controllability and Observability.

Learning Resources

Text Books

B.C.Kuo, *'Automatic Control systems'*, John Wiley and Sons, 8th edition,2003.
K.Ogata, *'Modern Control Engineering'*, Prentice Hall of India Pvt. Ltd., 5th edition, 2010.

References

I.J.Nagrath and M.Gopal, *'Control system Engg'*, New Age International (P) Limited Publishers,5thedition, 2007.
Norman S. Nise, *'Control system engineering'*, Wiley India, 5th edition 2000.

Video Reference links:

Prof. MadanGopal, NPTEL- IIT Delhi, '*Control Engineering',* URL: http://nptel.ac.in/courses/108102043/
Prof. S.D. Agashe, NPTEL-IIT Bombay, '*Control Engineering*', URL: http://nptel.ac.in/courses/108101037/
Prof. MadanGopal, NPTEL-IIT Delhi, '*Control Engineering*', URL: http://nptel.ac.in/courses/108102044/

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

CO 1	Analyze controllability and observability of linear systems.
CO 2	Design state-space controller and appropriate (deterministic) observer.
CO 3	Design controller with frequency design methods.
CO 4	Apply root-locus method for analysis and synthesis.
CO 5	Apply pole placement controller design approach.
CO 6	Design linear quadratic regulator for discrete-time systems.

Assessment Method

Assessment Tool	Weekly tests (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-II

20EE3104	Control Systems Lab	PCC	0L: 0T: 3P	1.5 credits

Course learning objective:
The objective of the lab is to design a system and calculate the transfer function, analyzing the stability of the system (both open and closed loop, with positive and negative feedback) with time domain approach and frequency response analysis, using MATLAB and also developing the system which is dynamic in nature with state space analysis approach.

List of Experiments:

1. Time response of Second Order systems using MATLAB
2. Characteristics of Synchros
3. Programmable Logic Controller-Study and verification of truth tables of logic gates, simple Boolean expressions and application of speed control of motor
4. Effect of feedback on DC servo motor
5. Transfer function of DC motor
6. Effect of P, PD, PI, PID Controller on second order systems.
7. Lag and Lead compensation - Magnitude and phase plot
8. Position control of DC motor.
9. Temperature controller using PID
10. Characteristics of AC Servo motor.
11. PSPICE simulation of of P, PD, PI, PID Controller using Op-Amp for second order systems
12. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant systems using MATLAB.
13. State space model for classical transfer function using MATLAB

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

CO1	Recognize the symbols for the different parts of a block diagram: functional blocks, summing blocks and branch points
CO2	Model a mechanical (masses, dampers and springs) and electrical system (inductors, resistors, capacitors) in the form of a transfer function
CO3	Determine the impulse, step, and ramp response of a system, given a transfer function model
CO4	Perform Routh's stability criterion and root locus of a system to determine stability

CO5	For systems with unknown values, determine the range of values for which the system will be stable and explain how adding a pole or a zero affects the stability
CO6	Analyze feedback control systems in the time and frequency domain to use state space concepts to describe systems
CO7	Recognize the "type" of a system (based on the number of free integrators) and discuss the expected error characteristics as related to step, ramp, and acceleration inputs
CO8	Interpret design criteria as related to the closed loop pole location on the complex plane
CO9	Draw the Frequency response plots like Bode, Nyquist and Polar plots (magnitude and phase) for a given transfer function
CO10	Design feedback compensators to achieve a set of desired closed loop system characteristics and design a compensator in the frequency domain to meet specific design requirements using a lead compensator, lag compensator, or lead-lag compensator

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

ENGINEERING SECOND YEAR: SEMESTER-II

22EC2203	**Linear Integrated Circuits**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objectives

To study the basic principles, configurations and practical limitations of op-amp.
To understand the various linear and non-linear applications of op-amp
To analyze and deign op-amp oscillators, single chip oscillators and frequency generators
To understand the operation of the most commonly used D/A and A/D converter types and its applications

Course content:

Unit-I (10 hours)
Feedback Amplifiers
Feedback concept, General characteristics of Negative feedback amplifier, Different feedback amplifiers (Voltge-series feedback, Current-series feedback, Current-shunt feedback, Voltage-shunt feedback), Effect of negative feedback on input and output impedances, gain & bandwidth

Unit-II (10 hours)
Operational Amplifiers
Ideal op-amp parameters, non-ideal op-amp, opamp in negative feedback, bandwidth and slew rate on circuit Performance.
Op-amp applications- summing amplifier, integrator, differentiator, Instrumentation amplifier, V to I and I to V converter, comparator, precision Rectifier, log and antilog amplifier. Active filters.

Unit-III (12 hours)
Wave shaping circuits & Oscillators
Postive feedback concept, Barkhausen criterion and design of RC phase oscillators, Wien Bridge oscillator. Ring oscillator, LC oscillators and crystal oscillators, Multivibrators – Astable, Monostable and Bistable Multivibrators, Schmitt trigger, square and triangular waveform generators.

Unit-IV (8 hours)
DC-DC Converters
Introduction, Performance parameters of DC-DC converters, Frequency limiting parameters, Types of converters: Buck, boost and buck-boost.

Unit-V (10 hours)
PLL
Basic PLL topology and principle, Major building blocks of PLL- analog and digital phase detector,

VCO, applications of PLL.

Unit-VI (10 hours)
Data Converters
Analog vs discrete time signals, Sample-and-Hold circuits, ADC architectures (Flash ADC, Successive Approximation ADC, Dual slope ADC. DACs(Binary weighted resistors, R-2R DAC and current steering DAC). INL & DNL

Learning Resources

Textbooks
Behzad Razavi, '*Fundamentals of Microelectronics',* Wiley Publications
Sedra and Smith, *'Microelectronics Circuits',* Oxford Publications,6th Edition.
R Jacob Baker, 'CMOS Mixed Signal Circuit Design', Wiley Publications

Reference Books
Boylestad R. L. and L. Nashelsky, *'Electronic Devices and Circuit Theory'*, 10/e or 11/e, Pearson, 2009.
Millman J. and C. Halkias, *'Integrated Electronics'*, 2/e, TMH, 2010.
Neamen D., *'Electronic Circuit Analysis and Design'*, 3/e, TMH, 2006
Spencer R. R. and M. S. Ghausi, *'Introduction to Electronic Circuit Design'*, Pearson, 2003

Web Resources
Prof D Nagendra Krishnapura, NPTEL-IIT Madras, *'Analog Integrated Circuit Design'* URL: https://nptel.ac.in/courses/117106030/
Prof K Radhakrishna Rao, NPTEL-IIT Madras, *'Electronics for Analog Processing-II'*, URL: https://nptel.ac.in/courses/117106088/

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

CO1	Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
CO2	Elucidate and design the linear and nonlinear applications of an op-amp and special application ICs.
CO3	Explain and compare the working of multi vibrators using special application IC 555 and general purpose op-amp.
CO4	Classify and comprehend the working principle of data converters.
CO5	Illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication.

Assessment Method

Assessment Tool	Weekly tests (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electrical & Electronics Engineering

ENGINEERING SECOND YEAR: SEMESTER-II

22EC2283	**Linear Integrated Circuits Laboratory**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

1. Experimentally demonstrate the frequency response of amplifiers
2. Practical knowledge on different types of multivibrators and their applications
3. Introductory designs on Analog to Digital Converters
4. Practical exposure to CMOS circuit design especially operational amplifiers
5. Familiarization with CAD tool for analog circuit design

List of Experiments

1. Design and analysis of Feedback amplifiers.
2. Frequency response of inverting & non-inverting amplifier.
3. Design of an Instrumentation amplifier.
4. Schmitt trigger & Noise suppression using Bistable multivibrator.
5. Monostable & Astable multivibrator using opamp.
6. Design of amplifier using CMOS inverters.
7. Two – bit flash ADC design.
8. Design of a typical CMOS inverter(sizing) using EDA tool and finding transfer characteristics & finding the propagation delay.
9. Design of a two input CMOS NAND & NOR gates (sizing) using EDAtool.
10. Design of a fully differential single stage opamp using resistive loads using EDA tool
11. Design of a single stage opamp using diode connected load using EDA tool
12. Term Project(Designing Public Addressing System).

*EDA tool may be Mentor Graphics/Synopsys/Cadence tools

Note: It is mandatory to perform experiments (1-7) on LTspice tool before the experiment is done on hardware. All experiments must be unique, design specifications should not be common in the lab.

Course outcome:

After the completion of this Laboratory course, the student will be able to

CO 1	To analyze the frequency response of amplifiers
CO 2	Experimentally know the noise suppression in bistable multivibrators
CO 3	Utilization of IC 555 timer
CO 5	Design of Analog to Digital Converters
CO 6	Design of CMOS circuits using CAD tool
CO 7	Design of operational amplifiers
CO 8	Design of a prototype project using the concepts of analog electronic circuits

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

ENGINEERING SECOND YEAR: SEMESTER-II

20EE3101	Power Electronics	PCC	3L: 1T: 0P	4 credits

Course Learning Objectives:

1. To introduce the concept of semiconductors devices for high power supply and their applications.
2. To understand the need for Power Electronics Devices and Circuits and their basic operation.

Course content

Unit-I: Introduction **(10 hours)**

Introduction to Power Electronics, Power Semiconductor Devices: Power Diodes, power Transistors, power MOSFETs, IGBTs, GTOs, Thyristors, Basic theory of operation, characteristics, Ratings, Protection and cooling, line commutation and forced commutation circuits.

Unit II: Converters **(10 hours)**

Power Electronic converters: 1-phase / 3 phase rectifier circuits, 1-phase / 3 phase phase-controlled converters (Semi-converters, full–converters and Dual converters) using IGBT. Analysis and performance with passive and active load, Harmonics and power factor, Introduction to power quality.

Unit III: D.C converters **(6 hours)**

D.C-to-D.C converters (choppers): Buck, Boost and Buck-Boost type and various chopper configurations.

Unit IV: A.C converters **(8 hours)**

A.C-to-A.C converters: A.C voltage controllers, Cyclo-converters, Introduction to matrix converters

Unit V: Inverters **(10 hours)**

D.C–to-A.C converters (Inverters): 1-phase VSI in half bridge and full bridge configuration, CSI, Frequency and voltage control, Line-commutated inverters (LCIs).

Unit-VI: APPLICATIONS **(8 hours)**

Power system applications- Static AC circuit breaker, interconnection of renewable energy sources and energy storage systems to the utility, Industrial applications -Switch mode welder, Voltage source series resonant inverters in induction heating, solid state relay. Applications for DC-DC converters, fully integrated voltage regulators.

Learning Resources

Text Books

1. Daniel W Hart, *Power Electronics* Tata Mc Graw Hill

2. Issah Batterseh, *Power Electronic Circuits*, Wiley.

3. N. Mohan, T.M. Undeland & W.P. Robbins, *Power Electronics: Converter, Applications & Design*, John Wiley & Sons, 1989

4. Muhammad H. Rashid, *Power Electronics: Circuits, Devices, and Applications*, Pearson, 2009

Reference Books

2. Bimal K Bose, *Modern Power Electronics and AC motor Drives*, Pearson Publishers.

3. Joe H. Chow, Alex M. Stankovic, David J. Hill, *Power Electronics and Power Systems* Springer Publications.

Web Resources:

1. Prof. G. Bhuvaneshwari, NPTEL-IIT-Delhi, Power Electronics.

URL:https://archive.nptel.ac.in/courses/108/102/108102145/

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

CO1	Understand the need for Power Electronics Devices and Circuits and their basic operation.
CO2	Perform an analysis of driving and control and triggering circuits for Power Electronic converters
CO3	Perform an analysis of AC to DC converters (Single phase and three phase, controlled and uncontrolled), A.C Voltage controllers, DC to DC converters(choppers), and single phase D.C to A.C converters (Inverters) in square wave mode.

CO4	Perform Fourier analysis and knowledge of Power Quality issues associated with power electronic circuits.
CO5	Understand different applications of power electronics.

Assessment Method

Assessment Tool	Weekly tests (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-II

20EE3102	**Power Electronics Lab**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective:

The course is introduced to the students to enable laboratory scale practical knowledge about power system operation and performance analysis of both hardware and software.

List of Experiments:

1. To study the characteristics of Silicon Controlled Rectifier (SCR) and to find its holding and latching current
2. To study the switching characteristics of IGBT.
3. To study the switching characteristics of FET.
4. To study the full wave bridge rectifier circuit and understand its effects on power quality
5. To study single phase inverter with different loading conditions.
6. To study three phase inverter with different loading conditions
7. To study Sinusoidal Pulse Width Modulation
8. To study high frequency switching
9. To study the performance of DC-DC buck converter circuit at different duty ratios
10. To study the performance of single phase full bridge inverter circuit operating in square wave mode using IGBT
11. To study the performance of DC-DC boost converter circuit at different duty ratios

12. Generation of PWM pulses using microcontroller kit
13. Study of inverter fed adjustable speed drive for 3-phase induction motor
14. Single phase and 3-phase uncontrolled rectified with smoothing capacitor

Course Outcomes: Upon successful completion of the course, student should be able to

CO1	Understand the basic concepts of device characteristics and triggering techniques
CO2	Understand the operation of different type of rectifier/converter circuits with different loads
CO3	Understand the operation of choppers, AC voltage controllers and inverters

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

ENGINEERING THIRD YEAR: SEMESTER-I

22EC31XX	Digital Signal Processing	**PCC**	**3L: 1T: 0 P**	**3 credits**

Course Learning Objectives:

- To understand the mathematical approach to manipulate discrete time signals, which are useful to learn digital telecommunication
- To study the transformations on digital signals.
- To understand the concepts of digital filters

Course Contents:

UNIT- 1 **Introduction (10 hrs)**

A basic review of Signals and Systems, Basic elements of digital signal processing, Time domain representation of discrete time signals, Basic Operations on sequences including Sampling rate alteration, Classification of sequences. Discrete time systems, Time domain characterization of LTI DTS: Convolution sum, Impulse & Step Responses, Simple Interconnection schemes, Linear Constant Coefficient Difference Equations (of Finite- dimensional LTI DTS), Classification of LTI DTS: FIR & IIR, Recursive, & Non- recursive.

UNIT-II **Discrete Time Fourier Transform (DTFT) (10 hrs)**

Introduction, Fourier Transform Representation of aperiodic Discrete-Time Signals, Periodicity-convergence of DTFT, Properties of DTFT, Signal Transmission Through LTISystems,IdealandPracticalFilters,energyspectralDensity,PowerspectralDensity.

UNIT - III **Discrete Fourier Transform (DFT) (12 hrs)**

Sampling of DTFT, Discrete Fourier Transform(DFT) and its Inverse, DFT as a Linear Transformation, Properties of DFT, Linear Convolution Using the DFT, Filtering of Long Data Sequences Using DFT, Spectrum analysis Using DFT.

Fast Fourier Transform(FFT)

Introduction ,Computational Complexity of the Direct Computation of the DFT , Decimation- In-Time (DIT) FFT Algorithm, Decimation-in-Frequency (DIF) FFT Algorithm and their comparison, Inverse DFT using FFT Algorithm, A Linear Filtering. Approach to Computation of the DFT-The GoertzelAlgorithm ,The Chirp-z Transform Algorithm.

UNIT- IV (10 Hrs)

Z transforms

Introduction ,Bilateral (Two-sided) Z-transform , Relationship Between Z-transform and DTFT,Z-Plane, Region-of-Convergence for Z-transforms and their properties, properties of Z-transform, Z-Transform of Causal Periodic Signals, Inversion of the Z-transform, Analysis and Characterization of LTI Systems using theZ-transform.

The Unilateral (One-Sided) Z-transform, Properties of unilateral Z-Transform. Transient Response and Steady-State Response Block Diagrams Representation. Applications of Z-Transform in Signal Processing

UNIT - V (8 Hrs)

Filter Concepts

Introduction, Frequency Response and Filter Characteristics, Zero-Phase Filter, Linear phase Filter, simple FIR and IIR Digital Filter, All pass Filters, Minimum-Phase, Maximum-Phase and Non-minimum (Mixed) Phase Systems, averaging filter, comb filter, Notch filter.

UNIT-VI

Realization Of Digital Filters (10 Hrs) Introduction, FIR Filter, IIR Filter, Non-recursive and Recursive Structures, FIR Filter Structures, Basic Structures for IIR Systems , Lattice Structures for FIR and IIR systems.

Learning Resources:

Textbooks:

A.V.Oppenheim and R.W. Schaffer, *Discrete Time Signal Processing* , 3rd edition, Pearson Education/PHI,2014.

John G. Proakis,Dimitris G.Manolakis,*Digital Signal Processing, Principles, Algorithms, and Applications* , 4th edition, Pearson Education / PHI,2007

Reference books:

Sanjit K Mitra, *Digital signal processing: A computer base approach* ,4thedition, Tata McGraw Hill,2013

B.P.Lathi, Roger Green, Essentials of Digital Signal Processing, Cambridge university press.

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

CO 1	Interpret ,represent and process discrete/digital signals and systems
CO 2	Understand the spectral analysis of signals
CO 3	Design &analyze DSP systems like FIR and IIR Filter etc
CO 4	Familiarize with multirate signal processing
CO5	Familiarize with applications of Digital Signal Processing

Assessment Method

Assessment Tool	Weekly tests (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING THIRD YEAR: SEMESTER-I

22EE3101	**Power Systems-II**	**PCC**	**3L: 1T: 0 P**	**4 credits**

Course Learning Objectives:

- Interpret the entries of bus impedance and admittance matrices using the singular transformation method, step by step method to obtain primary data of load flow analysis.
- Build the algorithms to form the bus impedance and admittance matrices for various configurations of primitive networks.
- Outline the conditions of a power system to undergo steady-state, dynamic, or transient stabilities studies.

Course Contents:

UNIT- 1 Per Unit System of Representation and Power System Network Matrices (10 hours)
Per Unit system of Representation: Necessity, Advantages, Applications in Power Systems and Calculations. Single line diagram– Impedance diagram of a power system–Graph theory definition – Formation of element node incidence and bus incidence matrices – Primitive network representation, Y bus formation by direct and singular transformation methods.

UNIT-II Power Flow Studies (10 hours)
The necessity of power flow studies – Derivation of static power flow equations – Power flow solution using Gauss-Seidel Method – Newton Raphson Method (Rectangular and polar coordinates form) –Decoupled and Fast Decoupled methods – Algorithmic approach – Problems on 3–bus system only. Merits and demerits of different load flow techniques.

UNIT - III Symmetrical Components and Symmetrical Fault Analysis (10 hours) Symmetrical Components: Synthesis of Unsymmetrical Phasors from their symmetrical components, symmetrical components of unsymmetrical phasors, Power in symmetrical components, Sequence impedances – Synchronous machine – Transmission line and transformers – Sequence networks.
Symmetrical fault analysis: Short circuit current and MVA calculations, fault levels, application of series reactors.

UNIT- IV Unsymmetrical Fault Analysis (10 hours) Unsymmetrical fault analysis: Unsymmetrical Faults in power systems, Single Line to Ground Faults, Line to Line Faults, Double Line to Ground Faults, and Open-conductor Faults.

UNIT - V Power System Stability-I (10 hours)
Power System Stability Analysis Elementary concepts of Steady-state– Dynamic and Transient Stabilities– Description of Steady-State Stability Power Limit–Transfer Reactance–Synchronizing

Power Coefficient – Power Angle Curve

UNIT-VI Power System Stability-II (10 hours)
Determination of Steady-State Stability –Derivation of Swing Equation, Multi-Machine stability studies, Determination of Transient Stability by Equal Area Criterion–Applications of Equal Area Criterion–Methods to improve steady-state and transient stability.

Learning Resources:

Textbooks:
John J Grainger, W.D. Stevenson, "Power System Analysis", McGraw-Hill (India) Pub. Third Edition, 2011.
Kothari D. P. and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education; Fourth edition, 2011.
J Duncan Glover and M S Sarma, Thompson, "Power System Analysis and Design", Third Edition 2006

Reference books:
C.LWadhwa, "Electrical Power Systems", New Age International, Sixth Edition, 2012.
Hadi Saadat, "Power System Analysis", McGraw Hill, Second Edition, 2002.
S.S. Vadhera, "Power System Analysis & Stability", Khanna Publishers, Fourth Edition, 2005.

Web resources:
Dr. B. Das, Computer-Aided Power System Analysis, IIT Roorkee NPTEL URL:
https://nptel.ac.in/content/syllabus_pdf/108107028
Prof. AK Sinha, Power System Analysis, IIT Kharagpur. NPTEL URL:
https://www.nptel.ac.in/courses/108105067/

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

CO 1	Able to draw impedance diagrams for a power system network and to understand per unit quantities.
CO 2	Able to form a Ybus for power system networks.
CO 3	Able to find the fault currents for all types of faults to provide data for the design of protective devices.
CO 4	Able to analyze the steady-state, transient, and dynamic stability concepts of a power system.

Assessment Method

Assessment Tool	Weekly tests (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING THIRD YEAR: SEMESTER-I

22EE3181	**Power Systems Laboratory**	**PCC**	**0L: 0T: 3 P**	**1.5 credits**

Course Learning Objective

1. To learn the hardware components in the PS lab and get to know functioning
2. To perform experiments such as creating faults and see the response of CB and relay.
3. To perform experiments and testing and finding equivalent circuits etc.

List of Experiments

1. Calculation of Efficiency and Regulation for a Long Transmission line with R and RL Loads.
2. Calculation of ABCD Parameters for Short, Medium and Long Transmission Lines.
3. Characteristics of Percentage biased of Static/Electro Magnetic differential Relay.
4. Characteristics of Static Relay under Voltage/Over Voltage.
5. Measurement of % ratio error and phase angle of given current transformer by comparison.
6. Determination of Equivalent circuit of a 3-winding transformer.
7. Determination of positive, negative and zero sequences of a 3-winding transformer.
8. Determination of sequence impedances of a cylindrical rotor Synchronous Machine.
9. Fault Analysis on a Three Phase Transmission Line Model.
10. IDMT Characteristics of Over Current Relay.
11. Measurement of % ratio error and phase angle of given current transformer by comparison.
12. Measurement of % ratio error and phase angle of given potential transformer by comparison.
13. Simulation of String Insulators for Determination of Voltage Distribution and String Efficiency.

Course outcome After the completion of this Laboratory course, the student will be able to

CO 1	To get the exposure of various components in a PS lab
CO 2	To experience the happening of faults and observe how the response systems are working

CO 3	Able to do experiments on finding wiring, finding relay faults etc.

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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ENGINEERING THIRD YEAR: SEMESTER-I

22EG3183	**English-II Laboratory**	**HSC**	**0L: 0T: 3 P**	**1.5 credits**

Course objectives:

- To improve group discussion skills of the students
- To help the students to write their CV and Internship application
- To improve the telephonic etiquettes of the students
- To help the students to take decision on their career

Course Content

UNIT-I: (06 Contact Hours)
Group Discussion - How to think and analyze - How to initiate a topic - How to continue a topic - How to support or reject a point-of-view - How to defend your position - Managing distractions and mediating between contenders - How to summarize & conclude

UNIT-II: (06 Contact Hours)
Telephonic conversation & Etiquettes - How to introduce oneself - How to introduce the main issue - How to keep the other person engaged - How to convince the other person - How to complain without irritating. - Giving assurance and asking for clarification - How to end a formal telephonic conversation

UNIT-III: (06 Contact Hours)
Career Planning & Job-Skill Analysis - ASK: Talking about one's Attitudes, Knowledge, & Skills - SMART goals - Reading & Analysis of Job Advertisements

UNIT-IV: (06Contact Hours)
CV & Resume Writing - Difference between CV & Resume - Writing CV - Writing Resume - Writing Cover Letter

UNIT-V: (06 Contact Hours)
Application for Internship - Application for internship in Academic Labs - Application for internship in Industries - Follow up the Application with reminders and requests

UNIT-VI: (06 Contact Hours)
Interview Skills - Preparation for the Interview - Frequently asked questions - Dress Codes, Appearance, and Etiquettes. 6.4 Facing the Interview

References:

Business Communication Today, 12th Edition, Courtland L Bovee & John Thill, Pearson
British Council Material on Career Planning & Interviews
Master the Group Discussion & Personal Interview - Complete Discussion on the topics asked by reputed B-schools & IIMs by Sheetal Desarda, Notion Press
Group Discussion and Interview Skills by Priyadarshi Patnaik , Cambridge University Press India
The Ultimate Guide to Internships: 100 Steps to Get a Great Internship and Thrive in It by Eric Woodard
Telephone Etiquette by Robert DeGroot

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

CO 1	Get used to a variety of GDs to understand the principles, finer nuances, and intricacies of the art
CO 2	Get exhaustive information on how to prepare for internship and interview
CO 3	Write his/her CV to remain well-prepared for the interviews
CO 4	Take decision on his/her career goals and plans
CO 5	Attain professional speaking skills to enhance his/her employability skills.

Assessment Method:

Course Nature: LABORATORY

Internal Assessment (40 Marks)	External Assessment (60 Marks)
Record Writing– 10 Marks	Reading Comprehension – 15 Marks
Attendance – 10 Marks	Writing– 30 Marks
Continuous Assessment (Listening – 10 Marks + Oral Presentations – 10 Marks)	Speaking (Viva-Voce) – 15 Marks

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ENGINEERING THIRD YEAR: SEMESTER-I

22EE2203	**Introduction to Electrical Vehicles**	**PCC**	**3L: 0T: 0P**	**3 credits**

Course Objectives:

- To get familiar with EV ecosystem
- To understand Energy and EV subsystems
- To get familiar with Batteries
- To gain knowledge about Battery pack and get introduced to design parameters
- To familiarize with EV motors and controllers
- To get familiar with Chargers and charging stations

Unit-1

Overview of EVs,Batteries, Chargers. EV Subsystems, Forces acting on a moving vehicle,Aerodynamic drag, Rolling Resistance and Uphill Resistance, Power and Torque to accelerate.

Unit-2

Concept of drive cycles, energy used per cycle. Design of EV subsystem

Unit-3

Introduction to Battery Parameters, Need of Li-ion batteries, Batteries in future, Li-ion battery cells. Concept and Estimation of SoC,SoH. Battery pack development, Battery charging Techniques.

Unit-4

Fundamentals of Battery pack design, Introduction to Thermal, Mechanical and Electrical design. Introduction to BMS design. Swapping.

Unit-5

EV Motors and Controllers - Understanding Flow, Power and Efficiency, Torque Production in PMSM, architecture,Speed and Back EMF. Building blocks of thermal circuits.

Unit-6

EV chargers: slow and fast chargers, Public chargers,Introduction to protocol,Location of Chargers.

Course outcomes:

- Familiarize with EV ecosystem
- Energy and EV subsystems
- Concept of Batteries
- Understand about Battery pack and design parameters
- EV motors and controllers
- Chargers and different charging stations

Text / References:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

Web resources:

Fundamentals of Electric vehicles: Technology & Economics, IIT Madras
Prof. Ashok Jhunjhunwala Prof. Prabhjot Kaur Prof. Kaushal Kumar Jha Prof. L Kannan

https://nptel.ac.in/courses/108106170

Assessment Method

Assessment Tool	Weekly tests (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-II

22EE2283	**Electrical Vehicles Lab**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

1. To learn the hardware components and their maintenance, working principles etc.
2. To check the working and diagnose the condition of ignition and check the relay operations.

List of Experiments

1. Battery testing
2. Alternator testing
3. Starter motor testing
4. Diagnosis of ignition system
5. Diagnosis of automotive electrical wiring
6. Fault finding of relay & fuses in car using Off Board Diagnostics Systems (OBDS)
7. Relay & fuse Fault diagnostic of a car using OBDS
8. Simulation of equivalent circuit of a lead-acid and Li-Ion battery.
9. Simulation of battery parameters measurements and estimation
10. Passive battery management systems simulation
11. Active battery management systems simulation
12. Charging and discharging characteristics of a battery
13. Closed loop implementation of Bi-directional DC-Dc converter with two batteries
14. 2s, 4p battery pack design with passive BMS circuit
15. 4s, 4p battery pack design with active BMS
16. Simulation of battery charging by using non-isolated DC-DC converter
17. Simulation of battery charging by using non-isolated AC-DC converter
18. Simulation of battery charging system to analyze its impact on power distribution systems
19. Design and submission of lab project

Note: All the simulations must be performed and at least 6 experiments must be conducted in the hardware part.

Learning Resources

Textbooks

Mary Murphy, Electric and Hybrid Vehicles, Principles, Design and Technology, 2nd Edition

Reference books

Ioniq, I-Pace, Soul, Leaf, Zoe, Tesla S, X, 3, and e-Golf, Joining the Electric Vehicle Revolution

Web Resources

Course outcome After the completion of this Laboratory course, the student will be able to

CO 1	To learn the MATLAB environment, python scripting and its programming fundamentals
CO 2	Ability to write Programs using commands and functions
CO 3	Able to simulate and visualize the data of various formats
CO 4	Able to understand perform operations on applications related to different fields
CO 5	Able to perform simulation of a simple prototype design project in Electronics and communication and relevant fields

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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ENGINEERING THIRD YEAR: SEMESTER-I

To be filled ECE bos	**Embedded Systems**	**PCC**	**3L: 1T: 0P**	**3 credits**

Course Learning Objectives:

- Students shall learn about evaluation of embedded systems
- Students shall learn about PIC Unit
- Students shall learn about ARM processors
- Students shall learn about DSP processors
- Students shall learn about software limitations in embedded systems
- Students shall learn about networking of embedded systems

Course Content

Unit I **(6hours)**

Overview of Embedded Systems, Embedded System Architecture, Processor examples: ARM, PIC etc, Introduction to Embedded Hardware, Overview of micro controller and micro- processor, Vonnueuman Architecture, Hardvard Architecture, Advanced Hardvard Architecture, Introduction to PIC microcontroller.

Unit-II **(10 hours)**

Instruction format, Addressing modes, Instructions, Data transfer instructions, Arithmetic and Logical instructions, Bit oriented instructions, Control instructions, Assembly language programming, Interrupts in PIC, Interrupts timing, PIC input output pins, PIC timers, Watchdog timer, PWM mode in PIC, PIC peripherals, PIC examples.

Unit-III **(10hours)**

History, ARM Architecture and its versions, Basic ARM organization, Registers and its organization, Processor modes, Memory Organization, ARM Instruction set, ARM Data types, ARM interrupt processing, Stack organization, ARM input output system, Pipeline operation in ARM, Simple ARM based systems.

Unit-IV **(8 hours)**

Features of digital signal processors, DSP applications and DSP algorithms, DSP memory, Instruction sets and parallel instructions, System on chip, Memory, Memory organization, Virtual memory, Memory management Unit, BUS structure, Serial interfaces, Power aware architecture.

Unit-V **(6 hours)**

Requirement and features of software for embedded systems, Usage of C and java and its limitations, Fundamentals of embedded operating systems, Scheduling policies, Resource management, Embedded OS.

Unit-VI **(5 hours)**

Network embedded systems, Distributed embedded systems and its Architecture, Multi- processor networks, Ethernet and its features, Hardware modules, Protocols.

Learning Resources:

Textbooks

Wayne Wolf, 'Computers as components: Principles of Embedded Computing System Design', Morgan Kaufman publication, 2000.
Advanced Microprocessors and Peripherals – A. K. Ray and K. M. Bhurchandani, TMH, 2nd Edition 2006

Reference books:

Microprocessors and Interfacing, D. V. Hall, TMGH, 2nd Edition 2006.

Web resources:

Dr. Santanu Chaudhury, NPTEL-IIT Delhi, 'Embedded Systems', URL: URL: https://nptel.ac.in/courses/108102045/

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

CO 1	Understand evaluation of embedded systems
CO 2	Analyse the PIC Unit
CO 3	Analyse the ARM processors
CO 4	Analyse the DSP processors
CO 5	Understand the software limitations in embedded systems
CO 6	Understand the networking of embedded systems

Assessment Method

Assessment Tool	Weekly tests (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING THIRD YEAR: SEMESTER-I

To be filled ECE bos	**Embedded Systems Lab**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Content

1. Introduction to ARM Cortex M3 Processor
2. Introduction to Microcontroller Micro Controller

Experiments:

1. ALP to multiply two 16 bit binary numbers.
2. ALP to find the sum of first 10 integers.
3. ALP to find the number of 0's and 1's in a 32 bit data.
4. ALP to determine the given 16 bit number is ODD or EVEN.
5. ALP to write data in RAM.
6. Interface a simple Switch and display its status through Relay, Buzzer and LED.
7. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
8. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.
9. Interface a DAC and generate Triangular and Square waveforms.
10. Display Hello World message using Internal UART.
11. Demonstrate the use of an external interrupt to toggle an LED On/Off.
12. Using the Internal PWM module of ARM controller generate PWM and vary its duty cycle.
13. Interface and Control a DC Motor.
14. Interface a 4×4 keyboard and display the key code on an LCD.
15. Measure Ambient temperature using a sensor and SPI, ADC IC.
16. Interface 12 bit internal ADC to convert the analog to digital and display the same on LCD.
17. Design and submission of lab project

***ALP= Assembly level Program.**

Course outcomes: On successful completion of the course students will able to

CO 1	Understand the Architecture of ARM processor & its Registers
CO 2	Understand the Architecture and Interfacing of a Microcontroller
CO 3	Introduced to Assembly level programming and can implement basic operations
CO 4	Interface few basic devices with Micro controller.
CO 5	Control and Interface to devices to get a desired output.

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electrical & Electronics Engineering

ENGINEERING THIRD YEAR: SEMESTER-I

22EE3190	**Mini Project -1 (Socially Relevant Project)**	**PROJ**	**0L: 0T: 3P**	**1 credits**

Course Learning Objective

- To introduce the student to the existing real-time societal problems
- To make the student to identify a problem with the help of staff members
- To see that students can propose elaborately and try attempting to solve the problem to great extent.

List of Experiments

1. Identifying real-time societal problems
2. Idea proposal of multiple-solutions for the problem identified and discussion
3. Prototype design for an optimal solution

Note: The student is supposed to use the latest advancements of IOT/AI and general understanding on science and technology for identifying solution to a problem

Course outcome: After the completion of this Laboratory course, the student will be able to

CO 1	To understand the problems the society facing at present specifically at university/institute/ locality etc level.
CO 2	Shortlist some of the problems and do an exercise to choose a problem to solve
CO 3	Form a group with classmates and peers (worldwide), local authorities and understand deeply the roots of the problem and start initiation of solving it.
CO 4	Propose a solution method and prepare either hardware or software models depending upon the problem demands
CO 5	See his/her solution impact on the society and see or submit/suggest the models to the authorities for further implementation after approval satisfying he IP rights of RGUKT.

Assessment Method

Assessment Tool	Literature survey (Internal)	Seminar on observed case-studies (Internal)	Hardware/Software prototype development for identified problem (External)	Final Presentation and Viva-Voce (External)
Weightage (%)	20 %	20%	40%	20%

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ENGINEERING THIRD YEAR: SEMESTER-II

22HS3101	**Constitution of India**	**MC**	**1L: 0T: 0P**	**0 credits**

Course Learning Objectives

1. The basic objective of the course is to provide knowledge about institutions
2. It help to understands the processes to governing the society in a systematic way.
3. It helps to establish social Justice, Liberty, Equity and Fraternity.
4. The course will introduce the idea of political system in general
5. It provides idea about working process of constitutional institutions.
6. To create awareness about the functioning of the judicial system in India.

Course Contents

Unit-I **(2 hours)**
Introduction-Constitution' meaning of the term, Indian constitution sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and duties, Directive Principles of State Policy.

Unit-II **(3 hours)**
Union Government and its Administration-Structure of the Indian Union: Federalism, centre-state relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok sabha, Rajya sabha.

Unit-III **(2 hours)**
Election commission- Election commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Unit-IV **(2 hours)**
State Government and its Administration- Governor: Role and position, CM and Council of ministers, state secretariat: Organization, structure and functions.

Unit-V **(3 hours)**
Local Administration-District's Administration head: Role and importance, Municipalities: Introduction, Mayor and role of Elected Representatives, CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: Zilla Panchayat, Elected officials and their roles, CEO Zilla Panchayat: Position and role, Block level: Organizational Hierarchy (different departments), Village level: Role of elected and appointed officials, Importance of grass root democracy.

Unit-VI **(3 hours)**

Union Judiciary-Establishment and constitution of Supreme court, Appointment of Judges, Establishment of State High court, Establishment of common High court for 2 or more states, WRITS, PIL(Public Interest Litigation).

Learning resources

Text books

1. Durga Das Basu, *Constitutions of India*, 23rd ed, LexisNexis Publication.

Reference Books

Indian Polity by Laxmikanth
Indian Administration by Subhash Kashyap
Indian Administration by Avasti and Avasti
Government and Politics of India by W.H.Mrrison Jones
Constitution of India by J.C.Johari

Web Resources

1. https://unacademy.com/

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

CO 1	The students will understand their fundamental rules and duties.
CO 2	The students will learn the political system and the system of elections in India.
CO 3	It is to provide the students the institutions and processes to govern themselves in the manner they prefer.
CO 4	Students can also be able to utilize the laws and facilities provided by constution
CO 5	It will provide over all idea about our legal system.
CO 6	It will enable students more strong in terms of law and practice in day to day life.

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	0	0	100%	%100

**** PASS/FAIL course**

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ENGINEERING THIRD YEAR: SEMESTER-II

22EG3283	**English-III Laboratory**	**HSC**	**0L: 0T: 3 P**	**1.5 credits**

Course objectives:

- To improve interpersonal skills of the students
- To help the students to write professional letters and reports
- To practice the etiquettes to be used at workplace
- To reward hands on experience on managing meetings
- To imbibe leadership qualities in the students

Course Content

UNIT-I: (06 Contact Hours)
Professional Presentation - Collecting & Reading the materials to be presented - Analyzing the main points - Summarizing & concluding - Developing PPT - Delivery of the Presentation

UNIT-II: (06 Contact Hours)
Report Writing & Writing Professional Emails & Applications – Routine Reports – Investigative Reports - Professional Emails - Formal Letters and Applications

UNIT-III: (06 Contact Hours)
Agenda, Meetings, & Minutes - Setting the agenda for a meeting - Managing a meeting - Keynote address & vote of thanks - Publishing the minutes

UNIT-IV: (06 Contact Hours)
People skills and small talks (2 minutes) - Talking to professional executives - Talking to colleagues - Talking to the boss - Talking to your team - Talking to the media delegates

UNIT-V: (06 Contact Hours)
Corporate Etiquettes - How to introduce & greet - How to raise a question - How to clarify a doubt - How to say “yes” or “no” - Rapport building - Dining & winning - Counseling somebody - How to influence & motivate

UNIT-VI: (06 Contact Hours)
Life Skills - Leadership communication - Interpersonal communication - Stress management - Time Managemen

References:

***Business Communication Today*, 12th Edition, Courtland L Bovee & John Thill, Pearson**

British Council Material on communication

Training in Interpersonal Skills: Tips f: Tips for Managing People at Work by **Robbins and Hunsaker**

Soft Skills for Everyone, with CD Paperback –by Jeff Butterfield

Communication for business by Shirley Taylor, Pearson

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

CO 1	The art of professional presentation
CO 2	Write professional reports and letters
CO 3	Conduct a formal meeting
CO 4	Develop people skills and corporate etiquettes
CO 5	Gain the basic knowledge about leadership communication, stress management and time management

Assessment Method:

Course Nature: LABORATORY

Internal Assessment (40 Marks)	**External Assessment (**60 Marks)
Record Writing10 Marks	Reading Comprehension – 15 Marks
Attendance 10 Marks	Writing– 30 Marks
Continuous Assessment (Listening – 10 Marks + Oral Presentations – 10 Marks)	Speaking (Viva-Voce) – 15 Marks

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ENGINEERING THIRD YEAR: SEMESTER-I

22BM32XX	**Product Design and Innovation**	**HSC**	**1L: 0T: 0P**	**1 credit**

Note: Will be updated after dept of Management BOS.

Course Learning Objectives

1. To make awareness of the product design process.
2. This course will give an understanding of methods, tools and techniques applied
3. in product design.
4. This course will enhance the overview of innovation, product design process.
5. It will help to understand competitive benchmarking, aspects of human factors in
6. product design, tools for creative concept.
7. one of the objective of this course is to explain lectures including case studies and
8. hands-on exercises.
9. It will help students to generate creative ideas in to product design, considering
10. human factors aspects.

Course Contents

Unit I **(2 hours)**

Need for Innovation and design ,user Innovation , introduction to product and Product design, difference between Product development and product design.

Unit II **(2 hours)**

Need Problem Identification, user study by contextual enquiry, questionnaire study, Interview techniques, Persona and scenario mapping, product study and market study, design brief.

Unit III **(2 hours)**

Importance of human factors in product design, physical ergonomics, principles and issues, ergonomic assessment tool, Cognitive issues in product design.

Unit IV **(3 hours)**

Creative techniques and tools, concept generation, concept evaluation, concept design and presentations.

Unit V **(4 hours)**

Product prototype, model making work flow for prototype, tools and techniques for model making and prototyping, introduction to prototype driven innovation.

Unit VI **(2 hours)**

Overview of materials and processes, Evaluation tools and techniques for User- Product interaction

Learning resources

Text Books

1. Eppinger, S., & Ulrich, K., '*Product design and development'*, McGraw-Hill Higher Education, 2015.

2. Green, W., & Jordan, P. W. (Eds.), '*Human factors in product design: current practice and future trends'*. CRC Press, 1999.

Reference Books

1. Sanders, M. S., & McCormick, E. J., '*Human factors in engineering and design'*, Mcgraw-Hill book company, 1993.
2. Roozenburg, N. F., & Eekels, J., '*Product design: fundamentals and methods*' (Vol. 2). John Wiley &Sons Inc., 1995.

Web resources:

1. Dr. Debayan Dhar, NPTEL-IIT Guwahati, 'Product Design and Innovation'.
URL:https://nptel.ac.in/courses/107103082/

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

CO 1	A student will be able to understand basic of production design
CO 2	This subject will provide implication facilities of methods, tools and techniques of production design.
CO 3	Students can be able to correlate human factor and competitive benchmarking in product design.
CO 4	Students can have practical experience by implementing theory in case studies.
CO 5	They can enhance their creativity in product design.
CO 6	They will be able to create their own product design with implementation of available theoretical knowledge.

Assessment Method

Assessment tool	Monthly Seminar	Report submission (End Semester)	Total
Weightage (%)	75%	25%	100%

*Note:

1. Industry personnel/start company founding personnel may be included in this course.
3. In Assessment Method, among one of the monthly seminars, the student is supposed to submit video recording of seminar and the same should be played in the classroom.

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ENGINEERING THIRD YEAR: SEMESTER-II

22MC3201	**Career Development Course**	**MC**	**2L: 0T: 0P**	**0 credits**

Course Learning Objectives:

1.To enhance holistic development of students and improve their employability skills
2.To instill confidence in students and develop skills necessary to face the challenges of competitive exams and placements

Course Contents

Unit I **(1.5 hours)**
Number system: Base System, Exponents, Factorials, LCM & HCF, Properties of Numbers, Remainders, Successive Divisions
Sequence & Series: Arithmetic Progression, Harmonic Progression, Geometric Progression
Programming in C

Unit II **(8 hours)**
Arithmetic: Averages, Clocks & Calendars, Simple Interest & Compoud Interest, Mixture & Alligations, Percentages, Profit, Loss & Discounts, Ratio & Proportion, Speed, Time & Distance, Time & Work
Algebra: Binomial Theorem, Complex Numbers, Functions, Higher Degree Equations, Inequalities , Linear Equations, Logarithm, Quadratic Equations
Programming in C

Unit III **(6 hours)**
Geometry: Mensuration, Lines & Angles, Circles, Polygons, Triangles, Co-ordinate Geometry, Trigonometry
Probability & Statistics: Mean, Median & Mode, Permutation & Combination, Probability Set Theory & Venn Diagram
Programming using Data Structures

Unit IV **(7 hours)**
Logical Reasoning: Logical Sequence, Premise, Assumption & Conclusion, Binary Logic, Blood Relations, Linear & Matrix Arrangement, Seating Arrangement, Coding & Decoding, Statements & Assumptions Puzzles.
Analytical Reasoning: Course of Action Fact, Inference & Judgement, Logical Deduction, Statement & Assumption, Strong & Weak Arguments, Syllogism
Programming in Python

Unit V **(4.5 hours)**
Data Interpretation: Charts (Column, Pie & Bar), Tables Graphs (Line & Area), Venn Diagram,

Data Sufficiency.
Programming using JAVA
Reading Comprehension

Unit VI **(3 hours)**
Verbal Ability: Cloze Test Error Spotting, Fill in the blanks, Sentence Correction, Word Usage, Para jumbles, Paragraph Completion, Paragraph Summary
Programming using JAVA
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Learning resources
Text book
Sarvesh K Verma, *'Quantitative Aptitude Quantum CAT'*, arihant publications
Arun Sharma, Meenakshi Upadhyay, *' Verbal Ability and Reading Comprehension'* , McGraw Hill publications
Arun Sharma, *'Data Interpretation'*, McGraw Hill publications
Arun Sharma, *'Logical Reasoning'*, McGraw Hill publications

Reference books
Nishit K Sinha, 'Logical Reasoning and Data Interpretation', Pearson publications
Arun Sharma, *'Quantitative Aptitude'*, McGraw Hill publications

Web resources
https://unacademy.com/
https://www.tutorialspoint.com/
https://www.indiabix.com/

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

CO 1	Improve aptitude, problem solving skills and reasoning abilities
CO 2	Improve Verbal ability skills, Data interpretation skills
CO 3	Understand the basic techniques required for solving Reading Comprehension
CO 4	Familiarize with the written tests of competitive exams, campus placements and PSUs
CO 5	Collectively solve problems in teams and group
CO 6	Adopt and acquire new techniques in solving problem

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

**** Pass/Fail course.**
Note: All examinations will be only of objective type. CDPC team assistance is to be taken in preparation of question papers. For Monthly tests, negative marking may also be introduced

ENGINEERING FOURTH YEAR: SEMESTER-I

22BE4101	**Environmental Studies**	**MC**	**2L: 0T: 0P**	**0 credits**

Course Learning Objectives

- To provide knowledge about multidisciplinary nature of environment, various sources of natural energy.
- Understanding of ecosystem structure and function etc.
- Knowledge of biodiversity and conservation
- Understanding of problems caused by pollution and its impact
- Understanding about the various social issues related to environment.
- Awareness for the Environment and human health

Course Content

Unit-I **(5 hours)**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance; Need for public awareness.

Natural Resources: Renewable and Non Renewable Resources:

Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources' for sustainable lifestyles.

Unit-II **(5 hours)**

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem:-a. Forest ecosystem, b. Grassland ecosystem, c. Desert ecosystem, d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Unit-III **(5 hours)**

Biodiversity and It's Conservation: Introduction – Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a mega-diversity nation, Hot-sports of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation

of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit-IV **(5 hours)**

Environmental Pollution: Cause, effects and control measures of:-a. Air pollution, b. Water pollution, c. Soil pollution, d. Marine pollution, e. Noise pollution, f. Thermal pollution, g. Nuclear hazards, Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides.

Unit- V **(5 hours)**

Social Issues and the Environment: From Unsustainable to Sustainable development Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Case Studies, Environmental ethics: Issues and possible solutions.• Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness.

Unit-VI **(5 hours)**

Human Population and the Environment: Population growth, variation among nations, Population explosion – Family Welfare Programme, Environment and human health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Learning resources

Text book

1. Erach Bharucha, '*Textbook of Environmental studies'*, UGC

Reference Books

Clark RS, '*Marine Pollution'*, Clanderson Press, Oxford (TB).

De AK, '*Environmental Chemistry'*, Wiley Eastern Ltd.

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

CO1	Well understanding about their surrounding natural resources and their conservation
CO 2	Able to understand the ecosystem food chain and habitat.
CO 3	Develop the practices for conservation of biodiversity
CO 4	To well understand the pollution courses, impact and prevention from pollution
CO 5	Able to bring about an awareness of a variety of environmental concerns.
CO 6	It attempts to create a pro-environmental attitude and a behavioral pattern in society that is based on creating sustainable lifestyles.

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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List of Electives:

1. Power system protection and switchgear
2. Measurements and instrumentation
3. High Voltage Engineering
4. Embedded Systems
5. Electric Drives
6. Advanced Control Systems
7. Wind and solar energy systems
8. HVDC and FACTS
9. Distribution System Planning and Automation
10. Power system Protection
11. Switched mode power conversion
12. Smart electric grid
13. Introduction to Machine Learning
14. AI Techniques in Electrical Engineering
15. EV Batteries & Battery Management System
16. Fundamentals of Electric and Hybrid Vehicles

20EEXXXX	**Measurements and Instrumentation**	**PEC**	**3L: 1T: 0P**	**3 credits**

Course Objectives:

1. To understand the basic operation of different measuring instruments and thereby able to choose appropriate instruments for measuring different parameters.

Course Contents:

Unit-I: Measurements **(10 hours)**

Errors & classification, Measurement of voltage & current - permanent magnet moving coil and moving iron meters, Digital voltmeters and automation, guarding techniques.

Unit-II: Measurement of power and energy **(8 hours)**

Induction instruments, kVAh and kVARh meters, maximum demand indicators, digital multi-meters. Microprocessor based meters, Multifunctional meters, and algorithms for energy estimation**.**

Unit-III: Instrument transformers **(8 hours)**

Current and Potential transformers. Spectrum Analyzers, Data & Logic Analyzers.

Transducers Position transducers, force transducers, piezo-electric transducers, Hall effect transducers. Temperature measurement.

UNIT- IV: DC & AC Bridges **(12 hours)**

Method of measuring low, medium and high resistance – sensitivity of Wheat-stone's bridge – Carey Foster's bridge, Kelvin's double bridge for measuring low resistance, measurement of high resistance – loss of charge method. Measurement of inductance- Maxwell's bridge, Hay's bridge, Anderson's bridge - Owen's bridge. Measurement of capacitance and loss angle – Desaunty's Bridge - Wien's bridge – Schering Bridge.

Unit-V: Signal sources **(10 hours)**

Oscillators, Function generator & pulse generators. Oscilloscopes - CRO, Digital storage, Digital Phosphor Oscilloscopes. Analog & Digital Recorders and printers.

Unit-VI: Signal conditioners **(10 hours)**

Instrumentation amplifiers, voltage–current converters, voltage-frequency converters, analog multiplexers and de-multiplexers. Microprocessor Based Measurements, sampling frequency, Case Studies in Instrumentation.

Text Books:

1. A. K. Sawhney, 'A Course in Electrical and Electronic Measurements and Instrumentation', Dhanpat Rai & Co., 9th Edition, 2015.
2. Bouwens A. J., 'Digital Instrumentation', Tata McGraw Hill Publications, 16th Reprint (2008).
3. Kalsi H.S, 'Electronic Instrumentation', Tata McGraw-Hill Education, 3rd Edition, 2010.
4. Deobelin, 'Measurements Systems', Tata McGraw Hill Publications, 2nd Edition, 2010.

Reference Books:

1. W. D. Cooper, 'Electronic Instrumentation and Measurement Techniques', Prentice Hall of India Publications, 1st Edition, 2009.
2. Rangan C.S., 'Instruments Devices and System', Tata McGraw Hill Publications, 2nd Edition, 2009

Course outcomes: Upon completion of the course, the student will be able to

CO 1	Describe the working principle of different measuring instruments.
CO 2	Choose appropriate measuring instruments for measuring various parameters in their laboratory courses.
CO 3	Correlate the significance of different measuring instruments, recorders and oscilloscopes
CO 4	Develop a micro-processor based measuring unit for any practical application.

20EExxxx	High Voltage Engineering	PEC	4L: 0T: 0P	3 credits

Course Objectives:

1. To deal with the detailed analysis of Breakdown occurring in gaseous, liquids and solid dielectrics
2. To inform about generation and measurement of High voltage and current
3. To introduce High voltage testing methods

UNIT – I: Breakdown in Gases (8 hours)

Ionization processes and de-ionization processes, Types of Discharge, insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge.

Unit-II: Breakdown in Liquids (8 hours)

Breakdown in Liquids and Solid Insulating Materials Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

UNIT – III: Generation of High Voltages (6 hours)

Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

UNIT- IV: Measurements of High Voltages (6 hours)

Measurements of High Voltages and Currents Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

UNIT – V: Lightning and switching (8 hours)

Lightning and switching over-voltages Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over voltages, Protection against over-voltages, Surge diverters, Surge modifiers.

UNIT – VI: High Voltage Testing of Electrical Apparatus (8 hours)

High Voltage Testing of Electrical Apparatus and High Voltage Laboratories Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment.

Text books:

1. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.

Reference books:

1. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
2. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
3. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley &

Sons, 2011.

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

1. Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
2. Knowledge of generation and measurement of D. C., A.C., & Impulse voltages.
3. Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.
4. Knowledge of how over-voltages arise in a power system, and protection against these over voltages.

20ECXY26	**Embedded Systems**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives:

1. Students shall learn about evaluation of embedded systems
2. Students shall learn about PIC Unit
3. Students shall learn about ARM processors
4. Students shall learn about DSP processors
5. Students shall learn about software limitations in embedded systems
6. Students shall learn about networking of embedded systems

Course Content

Unit I: Overview of Embedded Systems (6 hours)

Overview of Embedded Systems, Embedded System Architecture, Processor examples: ARM, PIC etc, Introduction to Embedded Hardware, Overview of micro controller and micro-processor, Von Neumann Architecture, Harvard Architecture, Advanced Harvard Architecture, Introduction to PIC microcontroller.

Unit-II: Instruction set (10 hours)

Instruction format, Addressing modes, Instructions, Data transfer instructions, Arithmetic and Logical instructions, Bit oriented instructions, Control instructions, Assembly language programming, Interrupts in PIC, Interrupts timing, PIC input output pins, PIC timers, Watchdog timer, PWM mode in PIC, PIC peripherals, PIC examples.

Unit-III: ARM (10hours)

History, ARM Architecture and its versions, Basic ARM organization, Registers and its organization, Processor modes, Memory Organization, ARM Instruction set, ARM Data types, ARM interrupt processing, Stack organization, ARM input output system, Pipeline operation in ARM, Simple ARM based systems.

Unit-IV: DSP (8 hours)

Features of digital signal processors, DSP applications and DSP algorithms, DSP memory, Instruction sets and parallel instructions, System on chip, Memory, Memory organization, Virtual memory, Memory management Unit, BUS structure, Serial interfaces, Power aware architecture.

Unit-V: Software for embedded systems **(6 hours)**

Requirement and features of software for embedded systems, Usage of C and java and its limitations, Fundamentals of embedded operating systems, Scheduling policies, Resource management, Embedded OS.

Unit-VI: Network embedded systems **(5 hours)**

Network embedded systems, Distributed embedded systems and its Architecture, Multi-processor networks, Ethernet and its features, Hardware modules, Protocols.

Learning Resources:

Textbooks

1. Wayne Wolf, 'Computers as components: Principles of Embedded Computing System Design', Morgan Kaufman publication, 2000.
2. A. K. Ray and K. M. Bhurchandani, Advanced Microprocessors and Peripherals, TMH, 2nd Edition 2006

Reference books:

1. Microprocessors and Interfacing, D. V. Hall, TMH, 2nd Edition 2006.

Web resources:

1. Dr. Santanu Chaudhury, NPTEL-IIT Delhi, 'Embedded Systems',
URL: URL: https://nptel.ac.in/courses/108102045/

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

CO 1	Understand evaluation of embedded systems
CO 2	Analyse the PIC Unit
CO 3	Analyse the ARM processors
CO 4	Analyse the DSP processors
CO 5	Understand the software limitations in embedded systems
CO 6	Understand the networking of embedded systems

20EExxxx	Electric Drives	PEC	3L: 1T: 0P	3 Credits

Course Learning Objectives:

1. To introduce the drive system and operating modes of drive and its characteristics
2. To understand Speed – Torque characteristics of different motor drives by various power converter topologies
3. To appreciate the motoring and braking operations of drive.
4. To differentiate DC and AC drives

Course Content:

Unit-I: Review of Conventional Drives (6 hours)

Speed–torque relation, Steady state stability, methods of speed control, braking for DC motor, Multi quadrant operation, Speed torque relation of AC motors, Methods of speed control and braking for Induction motor, Synchronous motor. Criteria for selection of motor for drives.

UNIT-II: Converter Control of DC Drives (8 hours)

Analysis of series and separately excited DC motor with single phase and three phase converters operating in different modes and configurations.

Unit-III: Chopper Control of DC Drives (8 hours)

Analysis of series and separately excited DC motors fed from different choppers for both time ratio control and current limit control, four quadrant control.

Unit-IV: Design of DC Drives (6 hours)

Single quadrant variable speed chopper fed DC drives, Four quadrant variable speed chopper fed DC Drives, Single phase/three phase converter, Dual converter fed DC Drive, current loop control, Armature current reversal, Field current control, Different controllers and firing circuits, simulation.

Unit-V: Inverter fed AC Drives (8 hours)

Analysis of different AC motor with single phase and three phase inverters Operations in different modes and configurations, Problems and strategies.

Unit-VI: Inverter fed AC Drives cntd. (6 hours)

Analysis of different AC motor with single phase and three phase cycloconverters. Operations in different modes and configurations.

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Learning Resources:

Text Books:

1. G K Dubey, Fundamentals of Electric Drives, CRC Press, 2002.
2. Murphy J.M.D, Turnbull, F.G, “Thyristor control of AC motor, Pergamon press, Oxford, 1988.
3. M.H. Rashid, "Power Electronics Circuits, Devices and Applications", P.H.I Private Ltd.

New Delhi, Second Edition, 1994
4. N. Mohanet.al."Power Electronics-Converters, Applications and Design", John Wiley & Sons(Asia)Private Ltd.,Singapore,1996.

5. R. Krishnan, "Electric motor drives: modeling, analysis and control, Pearson.

Reference:

1. Sheperal, Wand Hully, L.N. "Power Electronic and Motor control" Cambridge University Press Cambridge 1987
2. Dewan S. Slemon B., Straughen, A.G.R., "Power Semiconductor drives", John Wiley and Sons, New York 1984.

Course outcomes: Upon completion of the course, the student will be able to

CO 1	Identify the drawbacks of speed control of motor by conventional methods
CO 2	Differentiate Phase controlled and chopper-controlled DC drives speed-torque characteristics merits and demerits
CO 3	Understand Ac motor drive speed–torque characteristics using different control strategies its merits and demerits
CO 4	

20EExxxx	Advanced Control Systems	PEC	3L: 1T: 0P	3 Credits

Course Learning Objectives:

1. To understand and design discrete time control system.
2. To design PID controller using Ziegler-Nichols method.

Course Content :

Unit-I: Review of Modeling and Analysis of LTI Systems
Modeling of physical Systems. Design specifications and performance indices, Motion control systems, Transportation lags. Approximation of time-delay functions, Sensitivity of control systems to parameter variations. Effects of disturbance of signals. Disturbance rejection.

Unit-II: Analysis in state-space
A perspective on state-space design. State variables. State models for physical systems. SISO and MIMO systems. Solution of state equations. Transfer function. Eigen values and Eigen vectors. Jacobian linearization technique. State transformations and diagonalization. Transformation to phase-variable canonical form Controllability and observability. Duality property Stability.

Unit-III: Feedback control design
Continuous control design Proportional, derivative and integral control action. PID controller tuning rules Ziegler-Nichols method. Two degree of freedom control systems. Compensator design using Bode diagram in frequency response approach. Lag-Lead, Lag-lead compensator. Control law design for full state feedback by pole placement. Full order observer system. Observer based state feedback. Separation principal.

Unit-IV: Introduction to Discrete-time Systems
Basic elements of discrete-time control system. Z-transform and properties. Inverse Z-transform. Difference equation and its solution by Z-transform method. Z-transfer function. State diagram of digital systems. Time delay. Direct, cascade and parallel decomposition of Z-transfer functions. Stability in Z-domain, Jury's test.

Unit-V: Non-linear system
Classification and types of non-linearity. Phenomena peculiar to non-linear systems. Methods of analysis. Linearization based on Taylor's series expansion Jacobian Linearization.

Unit-VI: Non-linear system cntd
Phase trajectory and its construction. Phase-plane analysis of linear and non-linear systems. Existence of limit cycles. Describing function of typical non-linearities. Stability analysis by DF method. Introduction to DIDF. Popov's circle criterion. Stability analysis by Lyapunov' direct and direct methods, Lypunov'stheorem.

Text Books:

1. Ogata. K , Modern Control Engineering, PHI Learning
2. Kuo B.C. , Automation Control Systems, Prentice Hall

Reference Books:

1. Roy Choudhury D , Modern Control Engineering, Prentice Hall
2. Nagrath J.J., Gopal M, Control System Engineering, New Age Pub.
3. Schulz, D.G. and Mels..L., State Functions and Linear Control Systems, McGraw-Hill.
4. Stepheni, Shahian, Savant, Hostetler Design of feedback control systems, Oxford University Press.

Course outcomes: Upon completion of the course, the student will be able to

CO 1	To understand control strategies for non linear systems
CO 2	To understand feedback control design
CO 3	To understand design of PID controller
CO 4	To understand discrete time control systems

20EExxxx	Renewable energy systems	PEC	3L: 1T: 0P	3 Credits

Course Objectives:

1. To study the physics of wind power and energy
2. To understand the principle of operation of wind generators
3. To know the solar power resources
4. To analyze the solar photo-voltaic cells
5. To discuss the solar thermal power generation
6. To identify the network integration issues

Course contents:

UNIT - I Wind Power (10 hours)

Physics of Wind Power History of wind power, Indian and Global statistics, Wind physics, Betz limit ratio, stall and pitch control, Wind speed statistics-probability distributions, and Wind power-cumulative distribution functions.

UNIT - II Wind Power cntd (10 hours)

Wind Generator Topologies Review of modern wind turbine technologies, Fixed and Variable speed wind turbine, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converters. Generator configurations, Converter Control.

UNIT – III: Solar power (10 hours)

The Solar Resource Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

UNIT – IV: Solar power cntd. (10 hours)

Solar Photovoltaic Technologies-Amorphous, mono-crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power point Tracking (MPPT) algorithms. Converter Control.

UNIT - V Fuel Cells (10 hours)

The Fuel Cell-Low and High Temperature Fuel Cells Constructional Features of Proton Exchange-Membrane Fuel Cells–Reformers-Electrolyzer Systems and Related Precautions-Advantages and Disadvantages of Fuel Cells-Fuel Cell Equivalent Circuit-

UNIT - VI Network Integration Issues (10 hours)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Text books:

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.

Reference books:

1. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill,

1984.
2. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.
3. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.
4. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

Course Outcomes: At the end of this course, students will demonstrate the ability to
1.Understand the energy scenario and the consequent growths of the power generate renewable energy sources.
2.Understand the basic physics of wind and solar power generation.
3.Understand the power electronic interfaces for wind and solar generation.
4.Understand the issues related to the grid-integration of solar and wind energy systems

20EExxxx	HVDC and FACTS	PEC	3L: 1T: 0P	3 Credits

Course Learning Objective:

1. To compare EHV AC and HVDC systems .
2. To analyze Graetz circuit and also explain 6 and 12 pulse converters
3. To control HVDC systems with various methods and to perform power flow analysis in AC/DC systems.
4. To describe various protection methods for HVDC systems and Harmonics

Course Content:

Unit-I: HVDC Transmission:
DC Power Transmission: Need for power system interconnections, Evolution of AC and DC transmission systems, Comparison of HVDC and HVAC Transmission systems, Types of DC links, relative merits, Components of a HVDC system, Modern trends in DC Transmission systems.

Unit-II: Analysis of HVDC Converters:

Pulse number, choice of converter configurations, Analysis of Graetz circuit with and without overlap, voltage waveforms, Analysis of two and three valve conduction mode, Converter Bridge characteristics, Inverter mode of operation, voltage waveforms

Unit-III: Converter and HVDC Control:

Principles of DC link control, Converter Control characteristics, Control hierarchy Constant current Control, CEA Control, firing angle control of valves, starting and stopping of a dc link, Power control

Unit-IV: Power Flow Analysis in AC/DC Systems, Harmonics and Filters:

Ill effects of Harmonics, sources of harmonic generation, Types of filters–Design examples, elimination of harmonics by using converters, Modeling of DC links, solutions of AC-DC Power flow.

Unit-V: Flexible AC Transmission Systems (FACTS):

FACTS concepts and general system conditions: Power flow in AC systems, Relative importance of controllable parameters, Basic types of FACTS controllers, shunt and series controllers, Current source and Voltage source converters. Introduction to Unified Power Flow Controller, Basic operating principles, Conventional control capabilities, Independent control of real and reactive power.

Unit-VI: Static Shunt and series Compensators
Objectives of Shunt Compensation - Midpoint Voltage Regulation for Line Segmentation, End of Line Voltage Support to Prevent Voltage Instability, Improvement of Transient Stability.

Objectives of Series Compensation, Concept of Series Capacitive Compensation, Voltage Stability, Improvement of Transient Stability.

Learning Recourses:

Text Books:

1. K.R. Padiyar, HVDC Power Transmission Systems–Technology and System Interactions" New Age International Publishers
2. Narain G. Honorani, Laszlo Gyugyi "Understanding FACTS–Concepts and Technology of Flexible AC Transmission Systems"

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

CO1	Evaluate HVDC and EHVAC transmission
CO2	Analyze converter configurations used in HVDC and list the performance metrics.
CO3	Understand controllers for controlling the power flow through a dc link and compute filter parameters
CO4	Apply impedance, phase angle and voltage control for real and reactive power flow in ac transmission systems
CO5	Analyze and select a suitable FACTS controller for a given power flow condition

20EExxxx	Distribution System Planning and Automation	PEC	3L: 1T: 0P	3 Credits

Course Learning Objective:

1. To distinguish between transmission and distribution systems.
2. To understand design considerations of feeders
3. To understand about Distribution transformers.
4. To examine the power factor improvement and voltage control

Course Content:

Unit-I: Power sector in India (10 hours)
An overview of distribution systems, Distribution system planning-issues and aspects, Introduction to Distribution system forecasting techniques, Stochastic and time series techniques for forecasting, intelligent techniques based load forecasting techniques, Definitions and importance of various terms that characterize loads, Load management and types of tariffs

Unit-II: Distribution transformers (DTRs): (10 hours)
Basic design considerations, 3-ph and 1-ph DTRs-types of connections and its relevance in operation, Need for special types of distribution transformers, Cast resin, CSP, Amorphous core DTRs, Regulation and efficiency of transformers-use of predetermined curves

Unit-III: Sub-transmission system: (10 hours)
Sub-stations site selection procedure, Sub-station capacity expansion, Location of new sub-stations and their rating, Sub-station bus schemes, VD and PL calculations for a service area with four and six feeders, VD and PL calculations for a service area with n-feeders, Characteristics of primary systems, Voltage drop(VD) and power loss(PL) calculations, Importance of power factor in distribution systems, Capacitors and their role in improving power factor. OLTC

Unit-IV: Distribution system protection: (6 hours)
Distribution system protection devices, Problems in distribution systems and the need for automation. Radial systems, ring main systems, advantages and disadvantages.

Unit-V: Distribution system automation(DSA): **(8 hours)**

General schematic, DSA-Hardware modules and their functions, DSA-Software modules and their functions, DSA-Alternatives in Communication media, Communication protocols for DSA schemes and need for OSA, Examples of DSA schemes, Distribution system grounding.

Learning Resources:

Text Books:

1. Turan Gonen, Electric power Distribution System Engineering, CRC Press, II Edition
2. A. S. Pabla, Electric Power Distribution, TMH, Fifth Edition
3. James A Momoh: Electric Power Distribution, Automation, Protection and Control, CRC Press

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

CO1	Understand the characteristics and components of electric power distribution systems.
CO2	Analyze and evaluate the impact of geographical, demographical and economic factors on distribution systems
CO3	Understand the components of distribution automation systems.
CO4	Design, analyze and evaluate distribution system design based on forecasted data

20EEXXXX	**Power System Protection**	**PEC**	**3L: 1T: 0P**	**3 credits**

Course Learning Objectives: Describe how electric power systems are protected and how speed, dependability, and security are ensured. Be familiar with the protection requirements for generators, power lines, and transformers in an electric energy system. The main protection functions and their protection schemes are described in detail and the settings for them are computed.

Course Content

Unit-I :Numerical Relaying (6 Hours)
Introduction to Numerical Relaying- Faults in power system, Elements and features of protection scheme, Fault analysis review-sequence components, Numerical relaying concept. Phasor estimation-Discrete Fourier transform(DFT), recursive and Half cycle DFT, Least square technique, Frequency response of phasor estimation techniques in the presence of decaying DC.

Unit-II: Overcurrent protection (6 Hours)
Overcurrent protection-Overcurrent Relay Characteristics, Overcurrent Relay Coordination, Relay Coordination with Fuse. Directional Relaying- Introduction to Directional Relaying, Positive Sequence Directional Relay, Negative and Zero Sequence Directional Relay, Superimposed Component Based Directional Relaying

Unit-III: Distance Relaying (8 Hours)
Distance Relaying- Introduction to Distance Relay, Fault Classification, Apparent Impedance Calculation, Distance Relay Implementation, Application to Double Circuit Line, Multi-terminal Lines, Protection of series compensated lines. Effect of Fault Resistance, Load Encroachment, Power Swing, Power Swing Detection Techniques, Adaptive Distance Relaying, Communication Assisted Relaying Scheme

Unit-IV: Transformer protection (8 Hours)
CT and CVT response, Fiber Optic Sensors, Transformer protection-Introduction to Transformer Protection, Differential Relay, Steps in Differential Relay Processing, Inrush Detection, CT Saturation, Negative Sequence Differential and Restricted Earth Fault Relay

Unit-V: Differential protection (8 Hours)
Differential protection of Line, Bus bar protection, Network Protection with Renewable sources- Fault Characteristics of Renewable Sources, Protection Challenges of Distribution Systems with Renewables, Protection challenges of transmission systems with renewable sources

Unit-VI:Wide Area Measurement (7 Hours)
Traveling wave approach-Traveling Wave Basics, Protection using Traveling Waves, Fault Location using Traveling Wave. Wide Area Measurement Basics, Wide Area Measurement for Protection. PMU.

Learning Resources:

Text Books

1. *Computer relaying for power systems*- A. G. Phadke and J S Thorp, John Wiley and Sons Ltd 2009
2. Modern solutions for protection, control, and monitoring of electric power systems

Reference Books

1. *Power system relaying*, S. H. Horowitz and A. G. Phadke, John Wiley and Sons Ltd 2008
2. *Numerical differential protection*, Principles and Applications. G. Ziegler, 2012, Wiley
3. *Fundamentals of Power System Protection*, PAITHANKAR, Y. G., Bhide, S. R. ; PHI Learning Pvt. Ltd., 2022

Web Resources

1. https://onlinecourses.nptel.ac.in/noc22_ee101/course

Course outcomes: On successful completion of the course students will able to

CO 1	By identifying and formulating advanced problems and applying mathematics and science knowledge, students will demonstrate their ability to solve them
CO 2	Demonstrate the operation of a protective relay with simulated data by designing and coding i
CO 3	Analyze fault conditions for a small electric energy system under transient and steady state faults by developing algorithms and implementations
CO 4	Understand the main protection functions for component protection, such as overcurrent, directional, differential, distance, over/under voltage, over/under frequency, volts over hertz, and out-of-step protection.
CO 5	Developing and implementing special protection systems using traveling wave phenomena; developing and implementing special protection systems using state estimation

20EExxxx	**Switched Mode Power Conversion**	**PEC**	**3L:1T:0P**	**3 Credits**

Course Learning Objective:

1. To understand different non isolated and transformer-isolated power converters.
2. To understand analysis and design of switching regulator control.
3. To understand advanced techniques to improve efficiency and power density, such as use of resonant and soft-transition power converters.

Course Content:

Unit-I: DC/DC Converters (6 hours)
Basic topologies of buck, boost converters, buck-boost converters, and buck converter, isolated DC/DC converter topologies—forward, and fly-back converters, half and full bridge topologies, modeling of switching converters.

Unit-II: Current Mode and Current Fed Topologies (8 hours)
Voltage mode and current mode control of converters, peak and average current mode control, its advantages and limitations, voltage and current fed converters.

Unit-III: Resonant Converters (8 hours)
Need for resonant converters, types of resonant converters, methods of control, phase-modulation technique with ZVS in full-bridge topology, series resonant converter and resonant transition converter.

Unit-IV: Converter Transfer Functions (6 hours)
Application of state-space averaging to switching converters, derivation of converter transfer functions for buck, boost, and fly-back topologies.

Unit-V: Power Converter Design (8 hours)
Design of filter inductor& capacitor, and power transformer, Ratings for switching devices, current transformer for current sensing, design of drive circuits for switching devices, considerations for PCB layout.

Unit-VI: Controller Design (8 hours)
Introduction, mechanisms of loop stabilization, shaping E/A gain vs. frequency characteristic, conditional stability in feedback loops, stabilizing a continuous mode forward converter and discontinuous mode fly-back converter, feed-back loop stabilization with current mode control, the right-half plane zero.

Learning Resources:

Text Books:

1. Ned Mohan Tore M. Undeland: Power Electronics: Converters, Applications, and Design, Edition3, John Wiley & Sons, 2007.

2. Abraham I. Pressman, "Switching Power Supply Design", Mc Graw Hill International, Second Edition, 1999.

Reference books:

1. P.C. Sen, Modern Power Electronics, S. Chand-2004.

2. Andrzej M. Trzynadlowski Introduction to Modern Power Electronics, 2nd Edition, illustrated Publisher John Wiley & Sons, 2010.

3. Muhammad H. Rashid, Power electronics hand book, ISBN: 81 8147 367 1

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

CO1	Understand isolated and non-isolated DC-DC converters and their operation in continuous conduction mode and discontinuous conduction mode.
CO2	Calculate minimum inductance, capacitance in single switch DC-DC converters.
CO3	Apply current control and voltage control methods to regulate the output power.
CO4	Design DC-DC converters and evaluate the stability of the system

20EExxxx	Smart Electric Grid	PEC	3L:1T:0P	3 Credits

Course learning objective:

This course mainly focuses on basic fundamentals of smart grid for its implementation in the existing power system network. This course provides an overview of smart grid and its applications in potential sectors of Modern power systems. It also provides detailed utility level analysis in terms of energy management, network analysis and operation of smart grids. The course also explores issues in management, control, protection and monitoring of the grid with renewable energy source integration as well as in micro grids at remote locations.

Course content:

Unit I: Introduction to Smart Grid: (6 hours)
Issues related to conventional grids, Initial Overview of various smart grid measurement and communication technologies, smart grid protocols, Difference between conventional & smart grid, Architecture of Smart Grid, Smart Grid Initiative for Power Distribution Utility in India.

Unit II: Enablers for Smart Grid Technology (6 Hours)
Overview of Multi-agent System, Distributed Intelligence, Big Data Analysis, Cloud Computing, Software-Defined Networks (SDN), smart meters.

Unit III: Smart Grid Decision Support and operational technology (10 Hours)

Concepts of Visualization, Self-Healing, Congestion Management, Dynamic OPF, Security Assessment, Contingency Analysis, Dynamic State estimation, Stability Analysis, Intelligent Fault Management, Feeder Reconfiguration, Short Circuit Analysis, Topology Processing, Power Quality, Voltage VAR Control, advanced control of generators, improved FACTS devices

Unit IV: Smart Analytics (8 Hours)

Computational Intelligence, Wide Area Monitoring and Control Techniques, Demand Response Management, Predictive Asset Management, Forecasting Techniques

Unit V: New technology Integration (8 Hours)

Renewable Integration, Plug-in Electric Vehicle, Smart home and Smart City concepts, Cooperative grids

Unit VI: Smart Grid Market and Economics (7 Hours)

Energy market overview, Role of System Operators, DSO, and TSO under the smart grid, Transactive Energy

Learning Resources:

Text Books

1. Lars T. Berger and Krzysztof Iniewski, "Smart Grid Applications, Communications, And Security," Wiley, New Delhi, Aug 2015
2. Buchholz, Bernd M., Styczynski, Zbigniew, "Smart Grids – Fundamentals and Technologies in Electricity Networks", Springer, 2014
3. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, and Nick Jenkins, "Smart Grid: Technology And Applications," Wiley, New Delhi, Aug 2015.

Reference Books

1. James Momoh, "Smart Grid: Fundamentals of Design and Analysis," (I E E Power Engineering Series)– Wiley-Blackwell, Apr 2012
2. Takuro Sato, Daniel M. Kammen, Bin Duan, Martin Macuha, Zhenyu Zhou, and Jun Wu, "Smart Grid Standards: Specifications, Requirements, and Technologies," WileyBlackwell, Apr 2015.
3. Chen-Ching Liu, Stephen McArthur, Seung-Jae Lee, "Smart Grid Handbook", 3 Volume Set, Wiley, USA, 2016

Web Resources:

1. https://nptel.ac.in/courses/108107113

Course outcomes: On successful completion of the course students will able to

CO 1	Summaries various aspects of the smart grid Technologies, Components, Architectures and Applications
CO 2	Study and compare modern communication infrastructure and justify the feasibility of the same for smart grid applications.
CO 3	An overview of smart grid and its applications in potential sectors of Modern power systems.
CO 4	Provides detailed utility level analysis in terms of energy management, network analysis and operation of smart grids.
CO 5	The course also explores issues in management, control, protection and monitoring of the grid with renewable energy source integration as well as in micro grids at remote locations.
CO 6	Provides overview of the Smart Grid Market and Economics

20ECXY53	**Introduction to Machine Learning**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives

1.To provide abroad survey of approaches and techniques in machine learning.
2.To develop a deeper understanding of several major topics in machine learning.
3.To develop the basic skills necessary to pursue research in machine learning.

Course Content:

Unit-I: Introduction **(6hours)**

Introduction, Different types of Learning, Hypothesis space and Cross-Validation, Linear Regression, Introduction to decision trees, learning decision trees, over fitting, Python exercise on decision trees and linear regression

Unit-II: KNN **(7 hours)**

K-Nearest neighbor, feature selection, feature extraction, collaborative filtering, python exercise on KNN and PCA.

Unit-III: Bayesian Learning **(8hours)**

Bayesian Learning, Naïve Bayes, Bayesian Network, Python exercise on Naïve Bayes

Unit-IV: SVM **(8 hours)**

Logistic regression, Introduction to Support Vector Machine, SVM: The Dual formation, SVM: maximum margin with noise, nonlinear SVM and Kennel function, SVM: solutions to the dual problem, Python exercise on SVM.

Unit-V: MLP **(8hours)**

Multilayer Neural network, neural network and back propagation algorithm, deep neural network, python exercise on neural network.

Unit-VI: Clustering **(8 hours)**

Introduction to computational learning theory, sample complexity: finite hypothesis space, VC Dimension, Introduction to Ensembles, Bagging and Boosting, Clustering, means clustering, agglomerative hierarchical clustering, python exercise on clustering.

Learning Resources:

Text Books:

1.Tom Mitchell, Introduction to Machine Learning, TMH 2nd Edition.
2.Ethem Alpaydin, Introduction to Machine Learning, PHI, 2nd Edition.

Reference Books:

1.Andreas C. Müller, Sarah Guido, Introduction to Machine Learning with Python

O'Reilly Media, Inc. First Edition.

Web resources:

1. Prof. Sudeshna Sarkar, NPTE-IT-Kharagpur, Introduction to Machine Learning
   URL: http://nptel.ac.in/courses/106105152/

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

CO1	Understand the fundamental issues and challenges of machine learning like data, model selection, and model complexity.
CO2	Understand strengths And weaknesses of many popular machine learning approaches.
CO3	Design and implement various machine learning algorithms in a range of real world applications.

20EExxxx	AI Techniques in Electrical Engineering	PCC	3L:1T:0P	3 Credits

Course learning Objective:

1. To locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic and genetic Algorithms.
2. To observe the concepts of feed forward neural networks and about feedback neural networks.
3. To practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control
4. To analyze genetic algorithm, genetic operations and genetic mutations.

Course content:

Unit-I: Artificial Neural Networks:

Introduction, Models of Neuron Network-Architectures–Knowledge representation, Artificial Intelligence and Neural networks–Learning Process-Error correction learning, Hebbian learning– Competitive learning- Boltzmann learning, supervised learning-Unsupervised learning–Reinforcement learning-Learning tasks.

Unit-II: ANN Paradigms:

Multi-layer perceptron using Back propagation Algorithm (BPA), Self Organizing Map (SOM), Radial Basis Function Network-Functional Link Network(FLN), Hopfield Network.

Unit-III: Fuzzy Logic:

Introduction –Fuzzy versus crisp, Fuzzy sets-Membership function –Basic Fuzzy set operations, Properties of Fuzzy sets–Fuzzy cartesion Product, Operations on Fuzzy relations–Fuzzy logic–Fuzzy Quantifiers, Fuzzy Inference-Fuzzy Rule based system, Defuzzification methods

Unit-IV: Genetic Algorithms:

Introduction-Encoding–Fitness Function-Reproduction operators, Genetic Modeling–Genetic operators-Crossover-Single site crossover, Two point crossover–Multipoint crossover-Uniform crossover, Matrix crossover-Crossover Rate-Inversion& Deletion, Mutation operator–Mutation–Mutation Rate-Bit-wise operators, Generational cycle-convergence of Genetic Algorithm.

Unit-V: Applications of AI Techniques-I:

Load forecasting, Load flow studies, Economic load dispatch, Load frequency control, Single area system and two area system, Small Signal Stability (Dynamic stability),

Unit-VI: Applications of AI Techniques-II:

Fuzzy logic controller, intelligent control of systems, Reactive power control, Speed control of DC and AC Motors.

Learning Resources:

Text Books:

1. S. Rajasekaran and G.A.V.Pai Neural Networks, Fuzzy Logic & Genetic Algorithms, PHI, New Delhi,2003.
2. Rober J. Schalkoff, Artificial Neural Networks, Tata McGraw Hill, 2011

Reference books:

1. P.D. Wasserman; Neural Computing Theory & Practice, Van Nostr and Reinhold, NewYork, 1989.
2. Bart Kosko, Neural Network& Fuzzy System, PrenticeHall,1992
3. D.E. Goldberg, Genetic Algorithms, Addison-Wesley1999.

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

CO1	Understand concepts of ANNs, Fuzzy Logic and Genetic Algorithm.
CO2	Remember difference between knowledge based systems and Algorithmic based systems.
CO3	Understand operation of Fuzzy Controller and Genetic Algorithm.
CO4	Apply soft computing techniques for real-world problems

20EExxxx	**EV Batteries & Battery Management System**	**PEC**	**3L:1T:0P**	**3 Credits**

Course learning Objective:

1. To understand the operation of Battery Management Systems.
2. To understand the mathematical modeling of batteries.
3. To understand battery testing procedures.

Course content:

Unit-I: EV Batteries

Lead acid battery basics, Special characteristics of lead acid batteries, Battery life and maintenance, Battery charging, Summary. Nickel-based Batteries, Introduction, Nickel cadmium, Nickel metal hybrid batteries Sodium-based Batteries, Introduction, Sodium Sulphur batteries, Sodium metal chloride(Zebra) batteries Lithium Batteries, Introduction, the lithium polymer battery, charging requirements and charging standards.

Unit-II: Battery characteristics & parameters

Cells and Batteries, conversion of chemical energy to electrical energy, Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics; Efficiency of batteries; Electrical parameters-Heat generation-Battery design-Performance criteria for Electric vehicles batteries-Vehicle propulsion factors-Power and energy requirements of batteries

Unit-III: Battery modeling

General approach to modelling batteries, simulation model of a rechargeable Li-ion battery, simulation model of are chargeable NiCd battery, Parameterization of the Ni Cd battery model, Simulation examples.

Unit-IV: Battery pack and battery management system

Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Energy & Power estimation, Battery thermal management system, Battery Management.

Unit-V: Battery testing

Chemical & structure material properties for cell safety and battery design, battery testing, limitations for transport and storage of cell sand batteries, Recycling, disposal and second use of batteries. Battery Leakage: gas generation in batteries, leakage path, leakage rates.

Unit-VI: Battery disposal & recycling

Mechanical stress and pressure tolerance of cells, safety vents, Explosions: Causes of battery explosions, explosive process, Thermal Runway: High discharge rates, Short circuits,

charging and discharging. Environment and Human Health impact assessment of batteries, General recycling issues and drivers, Methods of recycling of EV batteries.

Learning Resources:

Text Books:

1. Ibrahim Dinçer, HalilS. Hamut and Nader Javani, Thermal Management of Electric Vehicle Battery Systems, John Wiley & Sons Ltd., 2016.
2. T R Crompton, Battery Reference Book 3rd Edition, Newnes-Reed Educational and Professional Publishing Ltd., 2000.

Reference books:

1. G. Pistoia, J. P. Wiaux, S. P. Wolsky, Used Battery Collection and Recycling, Elsevier, 2001
2. Guangjin Zhao, Reuse and Recycling of Lithium Ion Power Batteries, John Wiley & Sons. 2017.

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

CO1	Understand Battery management systems
CO2	Available recycling methods of batteries
CO3	Understand Characteristics of different batteries.
CO4	Understand SOC, and SOH estimation

20EExxxx	**Fundamental of Electric and Hybrid Vehicles**	**PEC**	**3L: 1T: 0P**	**3 credits**

Course Content:

Unit-I: Introduction to EV&HEV:
Past, Present & Feature of EV, Current Major Issues, Recent Development Trends ,EV Concept, Key EV Technology, State-of-the Art EVs & HEVs, Comparison of EV Vs IC Engine.

Unit-II EV System:
EV Configuration: Fixed & variable gearing, single & multiple motor drive, In-wheel drives

Unit-III: EV Parameters:
Weight, size, force, energy & performance parameters.

Unit-IV: 4 EV Propulsion:
Electric Motor: Choice of electric propulsion system, block diagram of EV propulsion system, concept of EV Motors, single motor and multi-motor configurations, fixed &variable geared transmission, In-wheel motor configuration, classification of EV motors, Electric motors used in current vehicle applications, Recent EV Motors, Comparison of Electric Motors for EV applications

Unit-V: Required Power Electronics &Control:
Comparison of EV power devices, converters for EV chargers, soft-switching EV converters, comparison of hard-switching and soft-switching converter, three-phase voltage-fed resonance dc link inverter, Basics of Microcontroller& Control strategies

Unit-VI: HEV (Hybrid Electric Vehicle):
Configuration of HEV (Series, Parallel, Series-parallel &Complex), Power Flow control, Examples. Power flow control in all HEV configurations, Examples of HEV system Performance.

Learning Resources:

Text books:

1. C.C Chan, K.T Chau, Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRCPress,2003.

Reference books:

1. Mehrdad Ehsani, Yimi Gao,Sebastian E.Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRCPress, 2004.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

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

CO 1	Understand the models to describe hybrid vehicles and their performance.
CO 2	Understand the different possible ways of energy storage
CO 3	Understand the different strategies related to energy storage systems.
CO 4	Understand the difference between Electric and Hybrid Vehicles.

List of Electives:

SNO	Stream	Electives	Web link	Remarks
1	Power Systems	Computer Aided Power System Analysis	https://nptel.ac.in/courses/108107028	
2		Power Quality	https://nptel.ac.in/courses/108102179	
3		Energy Management Systems and SCADA	https://nptel.ac.in/courses/108106022	
4		Power System Stability and Control.	https://nptel.ac.in/courses/108106026	
5		Non-Conventional Energy Systems	https://nptel.ac.in/courses/121106014	
6		DC Micro-grid and Control System	https://nptel.ac.in/courses/108107143	
7	Electrical Machines	Special Electromechanical Systems	https://nptel.ac.in/courses/108102156	
8		Modeling and Analysis of Electric Machines	https://nptel.ac.in/courses/108106023	
9	Control Systems	Introduction to Robotics	https://nptel.ac.in/courses/107106090	
10		Optimal Control	https://nptel.ac.in/courses/108105019	
11		Digital Control System	https://nptel.ac.in/courses/108103008	

12		Industrial Automation and control	https://nptel.ac.in/courses/108105062	
13		Intelligent Systems and Control	https://nptel.ac.in/courses/108104049	
14		Non-linear Systems	https://onlinecourses.nptel.ac.in/noc20_ee54/preview	
15	Signal Processing	Computer Vision and Image Processing-Fundamentals and Applications	https://nptel.ac.in/courses/108103174	
16		Estimation of Signals and Systems	https://nptel.ac.in/courses/108105059	
17		Medical Image Analysis	https://nptel.ac.in/courses/108105091	
18		Biomedical Signal Processing	https://nptel.ac.in/courses/108105101	
19		Statistical Signal Processing	https://nptel.ac.in/courses/108103158	
20		Digital Image Processing	https://nptel.ac.in/courses/106105032	
21	Power Electronics	Advanced Electric Drives	https://nptel.ac.in/courses/108104011	
22		Introduction to Hybrid and Electric Vehicles	https://nptel.ac.in/courses/108103009	
23		Advanced IOT Applications	https://nptel.ac.in/courses/108108123	

24	AI, IoT and Data Science	Deep Learning for visual computing	https://nptel.ac.in/courses/108105103	
25		Pattern Recognition	https://nptel.ac.in/courses/117108048	
26		Neural Networks and Applications	https://nptel.ac.in/courses/117105084	
27		Linux Programming & Scripting	https://nptel.ac.in/courses/117106113	
28		Reinforcement Learning	https://nptel.ac.in/courses/106106143	
29		Data Science for Engineers	https://nptel.ac.in/courses/106106179	
30		Deep Learning	https://nptel.ac.in/courses/106106184 https://nptel.ac.in/courses/106106201	
31		Data Analytics with Python	https://nptel.ac.in/courses/106106201	
32		Deep Learning for Computer Vision	https://nptel.ac.in/courses/106106224	
33		Computer vision	https://nptel.ac.in/courses/106106224	
34		Artificial Intelligence	https://nptel.ac.in/courses/106105077	
35		Digital System Design (taken from ECE-BOS)	----	

36	VLSI & Electronics	System Design Through Verilog	https://nptel.ac.in/courses/108103179	
37		Microelectronics: Devices To Circuits	https://nptel.ac.in/courses/108107142	
38		Introduction to VLSI Design	https://nptel.ac.in/courses/117101058	
39		Nano Electronics: Devices and Materials	https://nptel.ac.in/courses/117108047	
40	Others	Computer Networks (taken from ECE-BOS)	--	
41		Computer Architecture and Organization (taken from ECE-BOS)	--	

Note: Any new relevant course can be added to the above list with the approval from the Board of Studies (BoS) from time-to-time.

22EEXXYY	**Computer Aided Power System Analysis**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit 1: General Introduction

Modern Power system Operation and control, different types of Power system Analysis

Unit 2: Ac Power flow Analysis

Introduction, modeling of Power system components and formation of YBUS matrix, Formation of YBUS matrix in the presence of mutually coupled elements, Basic power flow equations and Gauss-Seidel load flow technique, Example of Gauss -Seidel load flow technique,Newton -Raphson (polar) load flow technique,Example of Newton-Raphson(polar) load flow technique,Newton Raphson (rectangular)load flow technique ,Example of Newton -Raphson (rectangular)load flow technique,Fast decoupled load flow technique,Example of Fast decoupled load flow technique,Ac-DC load flow technique,Example of AC-DC,load flow technique.

Unit 3: Sparse Matrices

Introduction to Sparsity and Gaussian elimination technique,Examples of Gaussian elimination technique,Optimal Ordering and LU factorization,Algorithm & examples of LU factorization ,storage scheme for Sparse matrices

Unit 4: Analysis of faulted Power system

ZBUS matrix formulation without mutual impedance,Example of ZBUS matrix formulation,Zbus matrix formulation considering mutual coupling between elements,Example of ZBUS matrix formulation in the presence of mutual coupling,Symmetrical Fault analysis & introduction to Symmetrical components,Sequence networks of Power system components,LG,LL,LLG fault analysis using sequence networks,Unbalance fault analysis using of ZBUS matrix,Example of Fault calculations for three phase and LG faults,Example of fault Calculations for LL,LLG faults,Open conductor fault analysis,Example of Open conductor fault analysis

Unit 5: Security Analysis

Introduction ,concept of GOSF,LOSF and D.C.load flow,Calculationof GOSF and determination of Thevenin's equivalent impedance,Calculation of LOSF with an example,Analysis of multiple contingencies,Example of multiple contingency analysis and contingency ranking methods

22EEXXYY	**Power Quality**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1 : Introduction

An Introduction to Power Quality , Standards and Monitoring .

Unit-2 : Passive and Active Shunt Compensation

Passive Shunt and Series Compensations , Active Shunt Compensation , Active Series Compensator , Unified Power Quality Compensators , Loads Which Cause Power Quality Problems .

Unit-3 : Passive Power Filters

Introduction to Passive Power Filters , Shunt Active Power Filters , Active Series Power Filters

Unit-4 : Hybrid Power Filters

Introduction to Hybrid Power Filters and Applications and Problems .

Unit-5 : AC-DC Converters

AC-DC Converters That Cause Power Quality , Improved Power Quality Converters- AC-DC Boost Converters , Improved Power Quality Converters- AC-DC Buck Converters , Improved Power Quality Converters- AC-DC Buck-Boost Converters , Three Phase AC-DC Improved Power Quality Converters .

Unit-6 :Multipulse Converters

Introduction to Multipulse Converters , Power Quality Improvement in Solar Energy Conversion System , Power Quality Improvement in Wind Energy Conversion System , Power Quality Improvement in Diesel Generator Set based Power Supply System , Power Quality Improvement in Distributed Generation Sources based Microgrids.

22EEXXYY	**Energy Management Systems and SCADA**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1 : ENERGY MANAGEMENT SYSTEMS (EMS)

Introduction to EMS and Evolution and Architecture of EMS , Working of EMS

Unit-2 : Operation States of a Power System

Operation States of a Power System , Network Analysis Functions , State Estimation .

Unit-3 : Power system security

Introduction to Power system security , Economic Dispatch and Optimal Power Flow

Unit-4 : SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)

Introduction SCADA , Hardware.

Unit-5 : Software and protocols

Introduction to Software and protocols , Power system automation .

Unit-6 : Applications of SCADA

Applications of SCADA , IEC61850 Standard for SCADA .

22EEXXYY	**Power System Stability and Control**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Introduction to power system stability problems, Synchronous machine modeling.

Unit-2

Turbine governor, exciter and load modeling. ,Small signal stability analysis- state space representation, modal analysis.

Unit-3

Power system stabilizer and its design,Transient stability analysis - numerical solutions: simultaneous implicit and partitioned explicit methods, simulation of dynamic response.

Unit-4

Analysis of unbalanced faults, direct method of transient stability, transient energy function method.

Unit-5

Phenomenon of sub synchronous resonance, improving transient stability.

Unit-6

Classification of voltage stability, modeling requirements, voltage stability analysis, voltage collapse and its prevention.

22EEXXYY	Non-Conventional Energy Systems	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-I
Global & National energy scenarios, Forms & characteristics of renewable energy sources

Unit-II
Solar radiation, Photovoltaics technology, configurations and applications.Flat plate collectors, Solar concentrators, Thermal Applications of solar energy,

Unit-III
Wind characteristics, Geography and other concepts Resource assessment, Horizontal & vertical axis wind turbines, Electricity generation and water pumping.

Unit-IV
Energy from biomass, Energy storage-Thermochemical, Biochemical conversion to fuels, biogas and its applications.

Unit-V
Ocean Thermal Energy Conversion (OTEC), Geothermal, Tidal and Wave energies, Material aspects of Renewable energy technologies and systems
.
Unit-VI: Battery basics, types Testing, performance of batteries , Flywheels and super capacitor

22EEXXYY	**DC Micro-grid and Control System**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Concept of Microgrids, Microgrid and distributed generation, Microgrid vs Conventional Power System, AC and DC Microgrid with Distributed Energy Resources.

Unit-2

Power Electronics for Microgrid, Power Electronic Converters in Microgrid Applications: Power Electronics for interfacing, Converter modulation techniques. Modeling of converters in microgrid power system(AC/DC , DC/AC , DC/DC).

Unit-3

Modeling of Renewable Energy Resources: Modeling of Wind Energy System, Modeling of Photovoltaic System, Modeling of Energy Storage System.

Unit-4

Microgrid Dynamics and Modeling, Microgrid Operation Modes and Standards, Microgrid Control Architectures, Intelligent Microgrid Operation and Control, Energy Management in Microgrid System.

Unit-5

DC Microgrid System Architecture and AC Interface, DC Microgrid Dynamics and Modeling, Control of DC Microgrid System, Applications of DC Microgrids.

Unit-6

Stability in Microgrid, Stability Analysis of DC Microgrid, DC Microgrid stabilization strategies (passive damping method), DC Microgrid Stabilization Strategies (Impedance/Admittance stability criteria), DC microgrid stabilization using nonlinear Techniques.

22EEXXYY	**Special Electromechanical Systems**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Special Electromechanical Systems(Introduction), Classification of Motors,single -phase Induction motor Analysis ,Starting of Single phase Induction motors , Single -phase Induction Motors Analysis

Unit-2

Introduction Motor Analysis by Symmetrical Components ,Modeling of 1-phase Induction Motor(one & Two Windings)

Unit-3

Asymmetrical Induction Motor Generalized Rotating Field Theory,Generalized Rotating Field Theory,Analysis Of Asymmetrical Machine by Generalized Rotating Field Theory ,Analysis of Asymmetrical Machine,Analysis of Asymmetrical Induction Machine ,Generalized Rotating -Field Theory of Wound Rotor Induction Machine having Asymmetry in Stator and Rotor Windings

Unit-4

Testing of Small Electrical Machines,Testing of single phase Induction Motors,Variable Reluctance (VR)Motor ,Switched Reluctance Motor

Unit-5

Stepper Motors,Induction Generators,Doubly Fed Induction Generators,Self Excited Induction Generators

Unit-6

Permanent Magnet Machines, Squareware Permanent Magnet Brushless Motor Drive ,Sine Wave Permanent -Magnet Brushless Motor Drives,Permanent Magnet Synchronous Motors

22EEXXYY	**Modeling and Analysis of Electric Machines**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1 : Introduction

Introduction to Modeling and Analysis of Electric Machines , Magnetic Fields , Magnetic Circuit , Singly Excited Linear Motion System , Linear and Cylindrical Motion Systems , Systems with Multiple Excitations ,Non-linear Magnetic Systems , Inductances in Constant Air gap Machines .

Unit-2 : Inductance in Salient Pole Machine

Inductance in Salient Pole Machine Introduction and Applications and Problems , Inductances of Distributed Winding .

Unit-3 : Induction Machines

Dynamic Equations of Induction Machines , Dynamic Equations of Salient Pole Synchronous Machine , Three-to-Two Phase Transformation , Induction Machine in Two-Phase Reference Frame , The Pseudo-Stationary Reference Frame , Induction Machine in Pseudo-Stationary Reference Frame , The Primitive Machine Equations .

Unit-4 : DC Machines

Dynamic Equations of DC Machines , Small Signal Model of DC Machine , Small Signal Behaviour of DC Machine , The Arbitrary Reference Frame , Induction Machine Equations in Arbitrary, Synchronous Reference Frames and Small Signal Modeling , Introduction to Field Oriented Control of Induction Machines , Space Vector Formulation of Induction Machine Equations ,

Unit-5 : Salient Pole Synchronous Machines - 1

Modeling of Salient Pole Synchronous Machines , Steady State Models – Induction Machine , Steady State Models – Salient Pole Synchronous Machine , Solution of Dynamic Equations of Induction Machine

Unit-6 : Salient Pole Synchronous Machines - 2

Reactances of Salient Pole Synchronous Machines , Sudden Short Circuit of Three Phase Alternator – Analytical Solution , Sudden Short Circuit of Three Phase Alternator – Numerical Simulation , Course Recapitulation and Assignments

22EEXXYY	**Introduction to Robotics**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Introduction,Evolution of Robotics,Kinematics- Coordinate transformations,Homogeneus Transformation Matrix,Industrial Robot- Kinematic Structures,Robot Architectures,Kinematic Parameters.

Unit-2

DH Algorithm- Examples, Forward Kinematics, Forward Kinematics- Examples, Inverse Kinematics,Inverse Kinematics- Examples,Differential Relations,Manipulator Jacobian and Statics.

Unit-3

Overview of Electric Actuators and Operational Needs,Principles of DC Motor Operation,DC Motor Equations and Principles of Control,DC Motor Control Regions and Principles of Power Electronics,Power Electronic Switching and Current Ripple,The H-Bridge and DC Motor Control Structure.

Unit-4

The Brushless DC Machine,Control of the Brushless DC Motor,The PM Synchronous Motor (PMSM) and SPWM,Principles of PMSM Control,Encoders for Speed and Position Estimation,Stepper Motors.

Unit-5

Introduction to Probabilistic Robotics,Recursive State Estimation: Bayes Filter,Recursive State Estimation: Bayes Filter Illustration.,Probability basics,Probability basics,Kalman Filter,Extended Kalman Filter,Particle Filter,Binary Bayes.

Unit-6

Velocity Motion Model,Odometry Motion Model,Occupa Grid Mapping,Range Finder Measurement Model,Localization Taxonomy,Markov Localization,Path Planning.

22EEXXYY	**Optimal Control**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Introduction to Optimization, Optimality Conditions for function of several variables,Unconstrained optimization problem (Numerical Techniques),Solution of unconstarined optimization problem using conjugate gradient method and Newton's Method.

Unit-2

Solution of contraint optimization problems - karush - kuhn Tucker (KKT) conditions,Post optimality analysis, convex function and its properties.

Unit-3

Quadratic optimization problem using Linear Programming,Matrix form of the Simplex Method,Solution of Linear Programming using Simplex Method - Algebraic Approach,Solution of LP problems with Two - Phase Method,Standard Primal and Dual problems,Relationship between Primal and Dual Variables,Solution of Quadratic Programming problem using Simplex Method.

Unit-4

Interior point method for solving optimization problems,Solution Non linear Programming Problem using Exterior Penalty Function Method,Solution of Non - linear Programming Problems using interior penalty function method,Multi - variable optimization problem,Dynamic Optimization Problem : Basic Concepts & Necessary and Sufficient Conditions.

Unit-5

Numerical Example and Solution of Optimal Control problem using Calculus of variation principle,Hamiltonian Formulation for Solution of optimal control problem and numerical example Performance Indices and Linear Quadratic Regulator Problem,Solution of Infinite - time LQR problem and stability analysis,Frequency Domain Interpretation of LQR Controlled System,Gain and Phase Margin of LQR Controlled System,The Linear Quadratic Gaussian Problem,Loop Transfer Recovery,Dynamic Programming for Discrete Time System.

Unit-6

Minimum - Time Control of a Linear Time Invariant System,Constraint in Control Inputs and State Variables,Norms for Vectors, Matrices, Signals and Linear Systems,Signal and System Norms,Internal Stability, Sensitivity and Complementary Sensitivity Functions,Plant Uncertainty and Standard form for

Robust Stability Analysis, Frequency Response of Linear System and Singular Value Decomposition of System,Control Problem Statement in H- alpha Framework.

22EEXXYY	**Digital Control System**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1 :

Introduction to Digital Control (Introduction , Discrete time system representation , Mathematical Modeling of Sampling Process , Data reconstruction , Appendix-1 **)**

Modeling discrete-time systems by pulse transfer function (Revisiting Z-transform , Mapping of s-plane to z-plane , Pulse transfer function , Pulse transfer function of closed loop system , Sampled signal flow graph , Appendix-2 **)**

Unit-2 :

Stability analysis of discrete time systems (Jury stability test , Stability analysis using bi-linear transformation , Appendix-3 **)**

Time response of discrete systems (Transient and steady state responses , Time response parameters of a prototype second order system , Appendix-4 **)**

Unit-3 :

Design of sampled data control systems (Root locus method , Controller design using root locus , Root locus based controller design using MATLAB , Nyquist stability criteria , Bode plot , Lead compensator design using Bode plot , Lag compensator design using Bode plot , Lag-lead compensator design in frequency domain , Appendix-5 **)**

Deadbeat response design (Design of digital control systems with deadbeat response , Practical issues with deadbeat response design , Sampled data control systems with deadbeat response , Appendix-6 **)**

Unit-4 :

Discrete state space model (Introduction to state variable model , Various canonical forms , Characteristic equation, state transition matrix , Solution to discrete state equation , Appendix-7 **)**

Controllability, observability and stability of discrete state space models (Controllability and observability , Stability , Lyapunov stability theorem , Appendix-8 **)**

Unit-5 :

State feedback design (Pole placement by state feedback , Set Point Tracking Controller , Full order observer , Reduced order observer , Appendix-9 **)**

Output feedback design (Output feedback design: Theory , Output feedback design: Examples , Appendix-10 **)**

Unit-6 :

Introduction to optimal control (Basics of optimal control , Performance indices , Linear Quadratic Regulator (LQR) design)

22EEXXYY	**Industrial Automation and control**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1:Introduction to Industrial Automation and control

Architecture of Industrial Automation Systems, Measurement Systems Characteristics, Temperature Measurement, Pressure, Force and Torque Sensors, Motion Sensing, Flow Measurement, Signal Conditioning, Signal Conditioning (Contd.), Data Acquisition Systems

Unit-2 : INTRODUCTION TO AUTOMATIC CONTROL:

Introduction to Automatic Control, P-I-D Control, PID Control Tuning, Feedforward Control Ratio Control, Time Delay Systems and Inverse Response Systems, Special Control Structures, Concluding Lesson on Process Control,

Unit-3 :INTRODUCTION TO SEQUENTIAL CONTROL

Introduction to Sequence Control, PLC , RLL, Sequence Control. Scan Cycle,Simple RLL Programs, Sequence Control. More RLL Elements, RLL Syntax, A Structured Design Approach to Sequence.

Unit-4 : Introduction to CNC MACHINES

PLC Hardware Environment, Introduction To CNC Machines, Contour generation and Motion Control, Flow Control Valves, Hydraulic Control Systems - I, Hydraulic Control Systems - II, Industrial Hydraulic Circuit.

Unit-5 :Pneumatic Control Systems - I

pneumatic Systems - II, Energy Savings with Variable Speed Drives, DC Motor Drives, DC and BLDC Servo Drives, Induction Motor Drives.

Unit-6 :Step Motor Drives BLDC Drives

Embedded Systems, The Fieldbus Network - I, The Fieldbus Network - II, Higher Level Automation Systems, Course Review and Conclusion.

22EEXXYY	**Intelligent Systems and Control**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Introduction to Intelligent Systems and Control: Linear Neural networks, Multi layered Neural Networks, Back Propagation Algorithm revisited, Non Linear System Analysis Part I, Non- Linear System Analysis Part II.

Unit-2

Radial Basis Function Networks: Adaptive Learning rate, Weight update rules, Recurrent networks Back propagation through time, Recurrent networks Real time recurrent learning, Self organizing Map - Multidimensional networks.

Unit-3

Fuzzy sets - A Primer, Fuzzy Relations, Fuzzy Rule base and Approximate Reasoning, Introduction to Fuzzy Logic Control.

Unit-4

Neural Control A review, Network inversion and Control, Indirect Adaptive Control of a Robot manipulator, Adaptive neural control for Affine Systems SISO.Adaptive neural control for Affine systems MIMO

Unit-5

Adaptive neural control for Affine systems MIMO, Visual Motor Coordination with KSOM, Visual Motor coordination - quantum clustering, Direct Adaptive control of Manipulators - Intro, NN based backstepping control.

Unit-6

Fuzzy Control - a Review, Mamdani type flc and parameter optimization, Fuzzy Control of a pH reactor,Controller Design for a T-S Fuzzy model, Linear controllers using T-S fuzzy model.

22EEXXYY	**Non-linear Systems**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-I:

Why nonlinear systems? - Non-linear Models of Physical Systems, Mathematical Preliminaries: Finite dimensional normed spaces, Euclidean space and its topology

Unit-II

Infinite dimensional Banach spaces - Contraction mapping theorem, Existence and Uniqueness results for solutions to non linear ODEs

Unit-III

ODEs as vector fields - One dimensional systems - Phase portrait of second order linear systems - Equilibrium points, linearization and their classification, Examples: Simple pendulum, Bead on a hoop, Lotka-Volterra models for predation and competition, biological transcriptional system, van der Pol oscillator and conservative systems, non linear circuits - Limit cycles

Unit-IV

Bifurcations of two dimensional flows: Saddle-node, pitchfork, transcritical and Hopf - their normal forms, Notions of stability - Lyapunov and LaSalle's theorems

Unit-V

Finding Lyapunov functions: Linear systems, variable gradient method - Center Manifold Theorem, Physical Non-linearities - Interconnections and feedback - Aizermann's conjecture – Passivity

Unit-VI

PR systems - Dissipation equality - Passive filters, : KYP Lemma - Popov and circle criterion

22EEXXYY	**Computer Vision and Image Processing-Fundamentals and Applications**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1 Introduction to Computer Vision and Basic Concepts of Image Formation

Introduction to Digital Image Processing, Introduction to Computer Vision ,Introduction to Computer Vision and Basic Concepts of Image Formation

Unit-2 Fundamental Concepts Image Formation 1 and Image Formation -2

Shape From shading ,Image Formation :Geometric Camera Model-1,Image Formation:Geometric-Camera Model -2,Image Formation :Geometric Camera Model-3, Image Formation in Stereo Vision Setup ,Image Reconstruction from a Series of Projections

Unit-3 Image Processing Concepts

Image transforms-1,Image Transforms-2,Image Transforms-3,Image Processing Concepts -2: Image Transforms -4,Image Enhancement,Image Filtering -1 Image Processing Concepts-3: Image Filtering-2,Colour Image Processing-1,Colour Image Processing-2,IMage Segmentation

Unit-4 Image Descriptors and Features

Image Features and Edge Detection,Edge Detection ,Hough Transform ,Image Texture Analysism -1,Image Texture Analysism -2 Image Descriptors and Features-2:Object Boundary and Shade Representations-1,Object Boundary and Shade Representation-2 ,Image Descriptors and Features-3:Interest Point Detectors,Image Features -HOG and SIFT

Unit -5 Fundamental of Machine Learning

Introduction to Machine Learning-1,Introduction to Machine Learning-2,Introduction to Machine Learning-3,Introduction to Machine Learning-4,Introduction to Machine Learning-5,

Unit-6 Application of Computer Vision

Artificial Neural Network for Pattern classification-1,Artificial Neural Network for Pattern classification-2, Introduction to Deep Learning,Gesture Recognition,background Modelling and Motion Estimation,Object Tracking ,Programming Examples

22EEXXYY	**Estimation of Signals and Systems**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Introduction to Estimation of signals and systems: Probability Theory ,Random Variables ,Function of Random Variable Joint Density, Function of Random Variable Joint Density.

Unit-2

Random Vectors Random Processes, Random Processes and Linear Systems, Some Numerical Problems ,Miscellaneous Topics on Random Process ,Linear Signal Models.

Unit-3

Linear Mean Sq.Error Estimation, Auto Correlation and Power Spectrum Estimation, Z-Transform Revisited Eigen Vectors/Values ,The Concept of Innovation ,Least Squares Estimation Optimal IIR Filters.

Unit-4

Introduction to Adaptive Filters ,State Estimation ,Kalman Filter-Model and Derivation ,Kalman Filter-Derivation (Contd...) ,Estimator Properties.

Unit-5

lman Filter, Kalman Filter-Case Study ,System identification Introductory Concepts ,Linear Regression-Recursive Least Squares ,Variants of LSE.

Unit-6

Least Square Estimation ,Model Order Selection Residual Tests ,Practical Issues in Identification , Estimation Problems in Instrumentation and Control ,Conclusion.

22EEXXYY	**Medical Image Analysis**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Introduction to Medical Image Analysis: X Ray and CT Imaging, Magnetic Resonance Imaging, Ultrasound Imaging, Optical Microscopy and Molecular Imaging.

Unit-2

Texture in Medical Images, Region Growing and Clustering, Random Walks for Segmentation, Active Contours for Segmentation, Systematic Evaluation and Validation.

Unit-3

Decision Trees for Segmentation and Classification, Random Forests for Segmentation and Classification, Neural Networks for Segmentation and Classification.

Unit-4

Deep Learning for Medical Image Analysis, Deep Learning for Medical Image Analysis (Contd.).

Unit-5

Retinal Vessel Segmentation, Vessel Segmentation in Computed Tomography Scan of Lungs, lession segmentation in brain mri.

Unit-6

Tissue Characterization in Ultrasound, metastopic region segmentation in lymph node biopsy.

22EEXXYY	**Biomedical Signal Processing**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Biomedical Signal Origin and Dynamics : Cardiovascular System, Measurement of blood pressure using sphygmomanometer, Action potential & Cardiac System, Electrocardiogram,
ECG lead configuration, Electroencephalogram, Central Nervous System, EEG lead position, EEG Recording Configuration, EEG applications, Electronystagmography(ENG), Electrogastrogram (EGG), phonocardiogram (PCG).

Unit-2

Artifact Removal: Introduction and statistical preliminaries, Case studies, Time Domain Filtering, Moving Average, Integration Filter, Derivative based Filter, Improved Derivation based filter, Frequency Domain Filtering, Optimal Filtering, Adaptive Filtering: Need and basics of adaptive filtering, LMS Adaptive Filtering, RLS Adapative Filtering, Summary of the Artifact Removal Techniques.

Unit-3

Event Detection: QRS Wave Detection: 1st and 2nd Derivative Based Methods, Pan Tompkin Algorithm and Dicrotic Notch Detection, Case Study: EEG Signal Description, EEG Rhythm Detection: Cross Correlation Coefficient, Cross Spectral Density, EEG Rhythm Detection: Match Filter,

Unit-4

Homomorphic Processing: Multiplicative Homomorphic System, Homomorphic Deconvolutions. Waveform Analysis: Signal Length, ECG waveform analysis, Envelop Extraction, Analysis of Activity.

Unit-5

Frequency Domain Characterisation: Periodogram, Averaged Periodogram, Blackman-Tukey Spectral Estimator, Daniels Spectral Estimator.

22EEXXYY	**Statistical Signal Processing**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Overview of Statistical Signal Processing, Probability and Random Variables,Linear Algebra of Random Variables, Random Processes, Linear Shift Invariant Systems with Random Inputs,White Noise and Spectral Factorization Theorem.

Unit-2

Linear Models of Random Signals, Estimation Theory 1, Estimation Theory 2**:** MVUE and Cramer Rao Lower Bound, Cramer Rao Lower Bound 2, MVUE through Sufficient Statistic, MVUE through Sufficient Statistic 2.

Unit-3

Method of Moments and Maximum Likelihood Estimators, Properties of Maximum Likelihood Estimator (MLE), Bayesian Estimators, Bayesian Estimators 2, Optimal linear filters: Wiener Filter, FIR Wiener filter.

Unit-4

Non-Causal IIR Wiener Filter, Causal IIR Wiener Filter, Linear Prediction of Signals 1, Linear Prediction of Signals 2, Linear Prediction of Signals 3,

Unit-5

Adaptive Filters 1, Adaptive Filters 2, Adaptive Filters 3, Review Assignment 2, Adaptive Filters 4, Adaptive Filters 4

Unit-6

Recursive Least Squares (RLS) Adaptive Filter, Recursive Least Squares (RLS) Adaptive Filter - 2, Review Assignment 4, Kalman Filter - 1, Vector Kalman Filter, Linear Models of Random Signals,

22EEXXYY	**Digital Image Processing**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1:

Spatial Domain Filtering:Introduction to Imaging Geometry,Sampling and quantization,Continuous intensity transforms,Piecewise continuous intensity transforms,Histogram Equalization,Histogram Specification,Local histogram equalization, Selective local enhancement,LinearSmoothing Filters (Linear),Smoothing Filters (Non-linear),Sharpening filters

Unit-2:

Filtering in the Frequency Domain:transform, K-L Transform(PrincipalComponentAnalysis), FourierTransform,Properties of Fourier Transform,Important Fourier transform pairs , Fast Fourier Transform (FFT), The sampling theorem,Filtering in Frequency domain: Low pass and High pass Contents filters,Filtering in Frequency Domain: Selective filters,Discrete Cosine Transform

Unit-3:

Image restoration:Introduction to Image restoration,Degradation due to known Noise models,Restoration using Spatial Filtering (Image Denoising) ,Model of Degradation,Image Reconstruction from Projections, Image compression:introduction to image compression,Symbol coding methods,Huffman Coding,Golomb Codes,Arithmetic Coding,Compression of binary images,Compression of grayscale images 30,JPEG compression,Predictive coding,Quantization,Compression in video,Digital Image Watermarking

Unit-4:

Wavelet based Image Compression:,Multiresolution Analysis,Wavelet Functions,Relation between Wavelet and Scaling function space,Relation between wavelet and scaling coefficients,Salient features of wavelets,JPEG-2000 Why another transform?

Unit-5:

Morphological Image Processing:introduction to morphological image processing,Erosion,Dilation,Opening and Closing,Hit-or-Miss Transform,Morphological Algorithms,Morphological Reconstruction.

Unit-6:

Image Segmentation:introduction to image segmentation,Edge Detection,Edge Linking (Region Boundary Detection),Segmentation,Image thresholding,Image thresholding ,Region based segmentation ,Segmentation Using Morphological Watersheds,The Use of Motion in Segmentation.

22EEXXYY	**Advanced Electric Drives**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1 :

Rotating machines , Modeling and control of rotating Electrical machines , Kron's primitive Machine model , Modeling of separately excited dc machines , Modeling of 3-phase symmetrical induction machine , Transformation in induction motor

Unit-2 :

Reference Frame Theory , Modeling of Synchronous machine , Mutual induction between Stator and Rotor of a Synchronous Machine , Vector control of Induction Motor , Response of the Vector control Induction Motor Drive , Current based estimation of Rotor Flux , Air gap flux oriented vector control of Induction motor

Unit-3 :

Speed sensorless vector control of Induction motor , Direct Torque control of Induction Motor , Direct Torque and Flux control of Induction motor , Block diagram of the DTC Induction Motor Drive , CSI Fed Induction motor Drive , Steady state operation of Synchronous Motor

Unit-4 :

Dynamics of vector controlled SM drive with variable field operation , Cycloconverter fed SM drive with Power factor operation , Principle of permanent magnet motors , Field structure with Alnico magnets , Basic Brushless DC motor , Trapezoidally excited BLDCM drive with current control

Unit-5 :

Dynamic modeling of Brushless DC Motor drive , Permanent magnet Synchronous Motor , Vector control PMSM , Modes of operation of Switched Reluctance Motor , Variable reluctance of Stepper Motor , Four phase 8/6 pole variable Reluctance type Stepper motor , Hybrid Stepper Motor , Utility friendly AC drivers

22EEXXYY	**Introduction to Hybrid and Electric Vehicles**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1 :

History of Electrical Vehicle (Historical Journey of Hybrids and Electric Vehicle , Economic and Environmental Impact of Electric Hybrid Vehicle **)**

Dynamics of Electric and Hybrid vehicles (Motion and Dynamic equations for vehicles **)**

Unit-2 :

Architecture of Hybrid and Electric Vehicles (Vehicle Power Plant and Transmission Characteristics , Basic Architecture of Hybrid Drive Trains and Analysis of Series Drive Train , Power Flow in HEVs , Torque Coupling and Analysis of Parallel Drive Train , Basic Architecture of Electric Drive Trains **)**

DC-DC Converters (DC-DC Converters for EV and HEV Applications I , Boost and Buck-Boost Converters , Multi Quadrant DC-DC Converters I , Multi Quadrant DC-DC Converters II , Multi Quadrant DC-DC Converters III , Questions Module 4 **)**

Unit-3 :

DC-AC Converters (DC-AC Inverter for EV and HEV Applications , Three Phase DC-AC Inverters , Voltage Control of DC-AC Inverters Using PWM **)**

A.C. Electrical Machines for Hybrid and Electric Vehicles (Induction Motors, their configurations and optimization for HEV/EVs , Induction Motor drives, their control and applications in EV/HEVs , Permanent magnet motors, their configurations and optimization , Permanent Magnet Motor drives, their control and applications in EV/HEVs , Switch reluctance motors, their configurations and optimization **)**

Unit-4 :

Permanent Magnet Machines for Hybrid and Electric Vehicles (Permanent Magnet Motors , Steady State Characteristics of Permanent Magnet Motors , Dynamic Model of PM Machines , Control of PM machines , Flux Weakening Control of PM machines **)**

Design of Hybrid and Electric Vehicles (Design Principles of HEVs I , Design Principles of HEVs II , Drive cycle and its detailed analysis , Sizing of Electric Machine for EVs and HEVs)

Unit-5 :

Energy Storage (Batteries , Mathematical Modeling for Lead acid battery , Alternative and Novel Energy Sources , Fuel Cell **)**

Control System for Electric and Hybrid Electric Vehicles (Energy management strategies and its general architecture , Rule and optimization based energy management strategies (EMS) , EMS Based on deterministic rules **)**

Unit-6 :

Regenerative braking (EMS Based on Fuzzy rule base , EMS Based on Global Optimization **)**

Design of Hybrid Electric vehicles (EMS Based on Real Time Optimization, Case Study of Design of a BEV I , Case Study of Design of a BEV II , Design of Series-Parallel HEV Drivetrain)

22EEXXYY	**Advanced IOT Applications**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1 :

Localization in IoT - Part 1 (Overview of localization using IoT sensors , Outdoor localization without GPS - I , Outdoor localization without GPS - II , Outdoor localization using elevation - pressure mapping)

Localization in IoT - Part 2 (Localization using IMU sensors - I , Localization using IMU sensors - II , Localization using IMU sensors - III , RFID based localization - I , RFID based localization - II)

Unit-2 : Sensors and protocols for next generation automobiles

Simulation of simple algorithms for object detection , Building smart vehicle for collision avoidance , Basic computer vision algorithms Part -1 , Basic computer vision algorithms Part -2 , Code walkthrough of computer vision algorithm , Introduction to LiDAR , Range estimation & Obstacle avoidance , Introduction to vehicle platooning

Unit-3 : Automotive IoT

Building blocks for autonomous vehicles - 1 , Building blocks for autonomous vehicles - 2 , On Board Diagnostics and protocols , Diagnostic services and fuel-injection ratio control unit , Real time event processing and Anomaly detection , OBD - II and stream processing demonstration

Unit-4 : Speech to text processing

Speech recognition Part - 1 , Speech recognition Part - 2 , Speech recognition Part - 3 , Speech recognition Part - 4

Unit-5 : Device Security

Device Security Part -1 , Device Security Part -2 , Device Security Part -4

Unit-6 :

Air quality monitoring (Need for air quality monitoring , Air quality : pollutants and standards , Introduction to air quality sensors , Calibration techniques for IoT air quality sensors , Sensor types : semiconductor and electrochemical , Air quality : Overview of system design , Air quality : System design - part 1 , Air quality : System design - part 2 , Air quality: Real time measurement for a drive cycle)

Case Studies (Introduction to First Responder networks , First Responders - Applications - Part 1 , First Responders - Applications - Part 2 , Cargo monitoring for tamper detection - Part 1 , Cargo monitoring for tamper detection - Part 2 **)**

22EEXXYY	**Deep Learning for visual computing**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Introduction to Visual Computing, Feature Extraction for Visual Computing, Feature Extraction with Python, Neural Networks for Visual Computing, Classification with Perceptron Model, Introduction to Deep Learning with Neural Networks, Multilayer Perceptron and Deep Neural Networks, Classification with Multilayer Perceptron.

Unit-2

Autoencoder for Representation Learning and MLP Initialization, MNIST handwritten digits classification using autoencoders, Fashion MNIST classification using autoencoders, ALL-IDB Classification using autoencoders, Retinal Vessel Detection using autoencoders, Stacked Autoencoders, MNIST and Fashion MNIST with Stacked Autoencoders, Denoising and Sparse Autoencoders, Sparse Autoencoders for MNIST classification, Denoising Autoencoders for MNIST classification.

Unit-3

Cost Function, Classification cost functions, Optimization Techniques and Learning Rules, Gradient Descent Learning Rule, SGD and ADAM Learning Rules, Convolutional Neural Network Building Blocks, Simple CNN Model: LeNet, LeNet Definition, Training a LeNet for MNIST Classification, Modifying a LeNet for CIFAR.

Unit-4

Convolutional Autoencoder and Deep CNN, Convolutional Autoencoder for Representation Learning, Alex Net, VGG Net, Revisiting AlexNet and VGGNet for Computational Complexity,
GoogleNet-Going Very Deep with Convolutions, GoogLeNet, ResNet - Residual Connections within Very Deep Networks, DenseNet - Densely connected networks, ResNet, DenseNet.

Unit-5

Space and Computational Complexity in DNN, Assessing the space and computational complexity of Very deep CNNs, Domain Adaptation and Transfer Learning in Deep Neural Networks, Transfer Learning a GoogLeNet, Transfer Learning a ResNet, Activation pooling for object localization, Region Proposal Networks(rCNN and Faster rCNN), GAP + rCNN, Semantic Segmentation with CNN, UNet and SegNet for Semantic Segmentation.

Unit-6

Autoencoders and Latent Spaces,Principle of Generative Modeling, Adversarial Autoencoders, Adversarial Autoencoder for Synthetic Sample Generation, Adversarial Autoencoder for Classification, Understanding Video Analysis, Recurrent Neural Networks and Long Short-Term Memory, Spatio-

Temporal Deep Learning for Video Analysis, Activity recognition using 3D-CNN, Activity recognition using CNN-LSTM.

22EEXXYY	**Pattern Recognition**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Overview of Pattern classification and regression :Introduction to Statistical Pattern Recognition, Overview of Pattern Classifiers ;**Bayesian decision making and Bayes Classifier :** The Bayes Classifier for minimizing Risk , Estimating Bayes Error; Minimax and Neymann's,Pearson classifiers.

Unit-2

Parametric Estimation of Densities: Implementing Bayes Classifier;Estimation of Class Conditional Densities, Maximum Likelihood estimation of different densities , Bayesian estimation of parameters of density functions, MAP estimates ,Bayesian Estimation examples; the exponential family of densities and MLestimates ,Sufficient Statistics & Recursive formulation of ML and Bayesian estimates; **Mixture Densities and EM Algorithm :** Mixture Densities, MLestimation and EM algorithm, Convergence of EM algorithm; overview of Nonparametric density estimation .

Unit-3

Nonparametric density estimation: Convergence of EM algorithm; overview of Nonparametric density estimation ,Nonparametric estimation,Parzen Windows, nearest neighbor methods;**Linear models for classification and regression** : Linear Discriminant Functions & Perceptron - Learning Algorithm and convergence proof , Linear Least Squares Regression; LMS algorithm .AdaLinE and LMS algorithm & General nonlinear least-squares regression ,Logistic Regression;Statistics of least squares method & Regularized Least Squares , Fisher Linear Discriminant .Linear Discriminant functions for multi-class case & multi-class logistic regression

Unit-4

Overview of statistical learning theory: Empirical Risk Minimization and VC-Dimension , Learning and Generalization & PAC learning framework , Overview of Statistical Learning Theory & Empirical Risk Minimization , Consistency of Empirical Risk Minimization , Consistency of Empirical Risk Minimization & VCDimension , Complexity of Learning problems and VCDimension VC-Dimension Examples & VC-Dimension of hyperplane.

Artificial Neural Networks for Classification and regression : Overview of Artificial Neural Networks, Multilayer Feedforward Neural networks with Sigmoidal activation functions & Backpropagation Algorithm , Representational abilities of feedforward networks , Feedforward networks for Classification and Regression & Backpropagation in Practice , Radial Basis Function Networks & Gaussian RBF networks , Learning Weights in RBF networks & K-means clustering algorithm.

Unit-5

Support Vector Machines and Kernel based methods: Support Vector Machines -- Introduction, obtaining the optimal hyperplane ,SVM formulation with slack variables & nonlinear SVM classifiers , Kernel Functions for nonlinear SVMs & Mercer and positive definite Kernels , Support Vector Regression and ε-insensitive Loss function, examples of SVM learning , Overview of SMO and other algorithms for SVM & ν -SVM and ν-SVR;SVM as a risk minimizer , Positive Definite Kernels; RKHS; Representer Theorem

Unit-6

Feature Selection, Model assessment and cross-validation : Feature Selection and Dimensionality Reduction & Principal ComponentAnalysis , No Free Lunch Theorem & Model selection and model estimation & Bias-variance trade-off , Assessing Learnt classifiers & Cross Validation; **Boosting and Classifier ensembles** : Bootstrap,Bagging and Boosting; Classifier Ensembles & AdaBoost , Risk minimization view of AdaBoost.

22EEXXYY	**Neural Networks and Applications**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1: Introduction to Artificial Neural Networks

Introduction to Artificial Neural Networks, Artificial Neuron Model and Linear Regression ,Gradient Descent Algorithm ,Nonlinear Activation Units and Learning Mechanisms ,Learning Mechanisms-Hebbian,Competitive,Boltzmann ,Associative memory ,Associative Memory Model

Unit-2: Statistical Aspects of Learning

Condition for Perfect Recall in Associative Memory ,Statistical Aspects of Learning, V.C. Dimensions: Typical Examples ,Importance of V.C. Dimensions Structural Risk Minimization ,Single-Layer Perceptions ,Unconstrained Optimization: Gauss-Newton's Method

Unit-3: Bayes Classifier & Perceptron

Linear Least Squares Filters ,Least Mean Squares Algorithm ,Perceptron Convergence Theorem ,Bayes Classifier & Perceptron: An Analogy ,Bayes Classifier for Gaussian Distribution ,Back Propagation Algorithm.

Unit-4: Radial Basis Function Networks

Practical Consideration in Back Propagation Algorithm ,Solution of Non-Linearly Separable Problems Using MLP ,Heuristics For Back-Propagation ,Multi-Class Classification Using Multi-layered Perceptrons ,Radial Basis Function Networks: Cover's Theorem ,Radial Basis Function Networks: Separability & Interpolation.

Unit-5: RBF Mechanisms

Posed Surface Reconstruction ,Solution of Regularization Equation: Greens Function ,Use of Greens Function in Regularization Networks ,Regularization Networks and Generalized RBF ,Comparison Between MLP and RBF ,Learning Mechanisms in RBF.

Unit-6: Introduction to Principal Components and Analysis

Introduction to Principal Components and Analysis ,Dimensionality reduction Using PCA ,Hebbian-Based Principal Component Analysis ,Introduction to Self Organizing Maps ,Cooperative and Adaptive Processes in SOM ,Vector-Quantization Using SOM.

22EEXXYY	**Linux Programming & Scripting**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1: Introduction-01
Linux Basics-I:History,Layers of Linux(Kernel,Shell,File System).
Linux Basics-II: different Linux Commands.

Unit-2: Introduction-02
Linux Basics-III: System Resource Commands,disk space commands,User commands,Manage file access,Managing resources.
Linux Basics-IV:File system commands,File showing details commands.

Unit-3: Linux Networking
Linux Networking -I ,Linux Networking -II ,File Transfer Protocol ,Domain Name System DFS(Distributed File System) ,AFS and NIS.

Unit-4: Perl Scripting
(practical extraction and report language)
PERL:History,different types of commands,Associate Arrays,String Matching,Functions,Operators,control Structures,Operations on Arrays,chomp,Scalar strings,Variables.

Unit-5: Tcl/tkScripting
Programming Using Tcl/Tk-I ,Programming Using Tcl/Tk-II ,Programming Using Tcl/Tk-III, Programming Using Tcl/Tk-IV ,More about Procedures ,TCP,Ports and Sockets ,I/O and Processes, Furniture Arranger ,Bindtags ,Tcl in Synopsys Tools.

Unit-6: Python Scripting
Python Programming ,Scope ,Iteration ,More about Regexps ,Advanced Functions ,Exception Handling, Examples of file Parsing ,Program on If Statement ,Program on Lists ,Makefiles.

22EEXXYY	**Reinforcement Learning**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1: Introduction to RL and Immediate RL

Probability basics ,Linear algebra ,Introduction to RL ,RL Framework and applications ,Introduction to Immediate RL ,Bandit Optimalities ,Value function based methodsUCB 1 ,Concentration Bounds ,UCB 1 Theorem ,PAC Bounds ,Median Elimination ,Thompson Sampling.

Uni-2: Policy Gradient Methods & Introduction to Full RL

Policy Search ,REINFORCE ,Contextual Bandits ,Full RL Introduction ,Returns,Value Functions and MDPs ,MDP Modeling ,Bellman Equation ,Bellman Optimality Equation ,Cauchy Sequence and Green's Equation ,Banach Fixed Point Theorem ,Convergence Proof.

Unit-3: Dynamic Programming & Monte Carlo Methods & Monte Carlo & Temporal Difference Methods

Lpi Convergence ,Value Iteration ,Policy Iteration ,Dynamic Programming ,Monte Carlo ,Control in Monte Carlo ,Off Policy MC ,UCT ,TD(0) ,TD(0) Control ,Q-Learning ,Afterstate.

Unit-4: Eligibility Traces & Function Approximation

Eligibility Traces ,Backward View of Eligibility Traces ,Eligibility Trace Control ,Thompson Sampling Recap ,Function Approximation ,Linear Parameterization ,State Aggregation Methods ,Function Approximation and Eligibility Traces ,LSTD and LSTDQ ,LSPI and Fitted Q.

Unit-5: DQN, Fitted Q & Policy Gradient Approaches

DQN and Fitted Q-Iteration ,Policy Gradient Approach ,Actor Critic and REINFORCE ,Policy Gradient with Function Approximation ,Hierarchical Reinforcement Learning ,Types of Optimality ,Semi Markov Decision Processes ,Options ,Learning with Options ,
Hierarchical Abstract Machines.

Unit-6: Hierarchical RL: MAXQ & POMDPs

MAXQ ,MAXQ Value Function Decomposition ,Option Discovery , POMDP Introduction ,
Solving POMDP.

22EEXXYY	**Data Science for Engineers**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1: Data science for Engineers Course Philosophy and Expectation & Linear Algebra
Introduction to R ,Variables and datatypes in R ,Data frames ,Recasting and joining of dataframes, Arithmetic,Logical and Matrix operations in R ,Advanced programming in R : Functions ,Control structures ,Data visualization in R Basic graphics ,Linear Algebra for Data science ,Solving Linear Equations ,Linear Algebra - Distance,Hyperplanes and Halfspaces,Eigenvalues,Eigenvectors.

Unit-2: Sample Statistics & Optimization
Statistical Modeling ,Random Variables and Probability Mass/Density Functions ,Sample Statistics, Hypotheses Testing ,Optimization for Data Science ,Unconstrained Multivariate Optimization ,Gradient (Steepest) Descent (OR) Learning Rule.

Unit-3: Optimization
Multivariate Optimization With Equality Constraints ,Multivariate Optimization With Inequality Constraints ,Introduction to Data Science ,Solving Data Analysis Problems - A Guided Thought Process.

Unit-4: Regression-I
Module : Predictive Modeling ,Linear Regression ,Model Assessment ,Diagnostics to Improve Linear Model Fit ,Simple Linear Regression Model Building ,Simple Linear Regression Model Assessment, Multiple Linear Regression.

Unit-5: Regression-II
Cross Validation ,Multiple Linear Regression Modeling Building and Selection ,Classification:Assigning classes to data points ,Logistic Regression ,Performance Measures ,Logistic Regression Implementation in R.

Unit-6: K - Nearest Neighbors (kNN)
K - Nearest Neighbors (kNN) ,K - Nearest Neighbors implementation in R ,K - means Clustering ,K - means implementation in R.

22EEXXYY	**Deep Learning**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-I:

History of Deep Learning, Fundamentals of Probability, Random variables and Joint Distribution, McCulloch Pitts Neuron, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent.

Unit-II:

Feed Forward Neural Networks, Back propagation, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD.

Unit-III:

Principal Component Analysis and its interpretations, Singular Value Decomposition, Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders.

Unit-IV:

Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization.

Unit-V:

Learning Vectorial Representations Of Words, Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet.

Unit-VI:

Recurrent Neural Networks, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs, Encoder Decoder Models, Attention Mechanism, Attention over images

22EEXXYY	**Data Analytics with Python**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Introduction to data analytics and Python fundamentals, Introduction to probability(Central tendency and dispersion, Probability distributions, Python demo for Distributions).

Unit-2

Sampling and sampling distributions, Hypothesis testing(Distribution of Sample means population and Variance, Confidence interval estimation), Hypothesis (Testing, Error).

Unit-3

Two sample testing and introduction to ANOVA(Post Hoc analysis, Randomize block design), Two way ANOVA and linear regression, (Estimation, Prediction of regression model residua analysis).

Unit-4

Linear regression and multiple regression, Categorical variable regression, Concepts of MLE and Logistic regression, Linear regression model vs Logistic regression model ,Confusion matrix, Performance of Logistic model.

Unit-5

ROC and Regression Analysis Model Building, C Test and introduction to cluster analysis, K-means of clustering, Hierarchical method of clustering.

Unit-6

Clustering analysis, Classification and Regression Trees (CART).

22EEXXYY	**Deep Learning for Computer Vision**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1 Introduction and Overview

Course Overview and Motivation; Introduction to Image Formation, Capture and Representation; Linear Filtering, Image in frequency domain and Sampling, Correlation, Convolution

Visual Features and Representations: Edge, Blobs, Corner Detection; Scale Space(Image pyramids and Filter banks) and Scale Selection; SIFT, SURF; HoG, LBP, etc.

Unit-2 Visual Matching and Deep learning

Visual Matching-Bag-of-words, VLAD; RANSAC, Hough transform; Pyramid Matching; Optical Flow, Review of Deep Learning, Multi-layer Perceptrons, Neural networks(review), Feedforward Neural networks and Backpropagation, Gradient Descent and Variants, Regulation in neural networks, Improving Training of Neural networks.

Unit-3 Convolutional Neural Networks (CNNs)

Introduction to CNNs; Evolution of CNN Architectures: AlexNet, ZFNet, VGG, InceptionNets, ResNets, DenseNets, Visualization and Understanding CNNs, Visualization of Kernels, Backprop-to-image/ Deconvolution Methods, Deep Dream, Hallucination, Neural Style Transfer; CAM, Grad-CAM, Grad-CAM ++, Recent Methods(IG, Segment-IG, SmoothGrad)

Unit-4 CNN's Cont. & RNN's

CNNs for Recognition, Verification, Detection, Segmentation: CNNs for Recognition and Verification (Siamese Networks, Triplet Loss, Contrastive Loss, Ranking Loss); CNNs for Detection: Background of Object Detection, R-CNN, Fast R-CNN, Faster R-CNN, YOLO, SSD, RetinaNet; CNNs for Segmentation: FCN, SegNet, U-Net, Mask-RCNN

Recurrent Neural Networks (RNNs): Review of RNNs(Backpropagation); CNN + RNN Models for Video Understanding: Spatio-temporal Models, Action/Activity Recognition

Unit-5 Attention Models & Deep Generative Models

Introduction to Attention Models in Vision; Vision and Language: Image Captioning, Visual QA, Visual Dialog; Spatial Transformers; Transformer Networks, Self attention and Transformers

Deep Generative Models: Review of (Popular) Deep Generative Models: GANs, VAEs; Other Generative Models: PixelRNNs, NADE, Normalizing Flows, etc

Unit-6 Applications and Trends of Generative Models

Variants and Applications of Generative Models in Vision: Applications: Image Editing, Inpainting, Superresolution, 3D Object Generation, Security; Variants: CycleGANs, Progressive GANs, StackGANs, Pix2Pix, etc

Recent Trends: Zero-shot, One-shot, Few-shot Learning; Self-supervised Learning; Reinforcement Learning in Vision; Other Recent Topics and Applications

22EEXXYY	**Computer Vision**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-I:

Fundamentals of Image Processing, Image transform, 2-D Projective Geometry and Homography and Properties of homography

Unit-II:

Camera geometry: Image formation in camera, pin-hole camera, principal point: mapping, offset, shifting of coordinates:: CCD camera: Projective camera, projective camera matrix, properties of projective camera matrix, camera center, zooming, rotation of the camera axis, vanishing points/lines::Stereo geometry: stereo setup, Epipolar Geometry, fundamental matrix essentials and properties, pure translation, general camera motion, estimation of fundamental matrix, the normalized 8-point algorithm, singularity constraints, retrieving the camera matrices, Affine Epipolar Geometry

Unit-III:

Feature detection: Harris Operator, Scale Invariant detection, HoG descriptors, finding key points, key point localization and orientations, Scale Invariant Feature transform, HAAR transform, region descriptors, Co-occurance matrix, Bag of visual words:: Feature matching: similarity measures, distance based matching criteria, K-D tree, choice of models, least square line fitting, Hough Transforms, RANSAC.

Unit-IV:

Interaction of Light and Surfaces, the Eye: A Camera, Physiology of color vision, color perception, standardizing color experience, Grassman's law, Linear color spaces: RGB, CIE color space, CIE chromaticity model, uniform color spaces: YIQ model, YCbCr space , opponent color processing, lighting conditions, color constancy computation methods, color demosaicing, Interpolation methods, suppression of impulsive noise, False colors.

Unit-V:

Time of flight range sensors, parametric curve(2D and 3D), parametric surfaces, second fundamental form, Eight visible surface types from signs curvature, Monge patches, finding step and roof edges in range images, characterization of edges, segmentation into planes via region growing, handling noise in range images, classification and clustering, processing pipeline, three major component of clustering, K-means clustering, k-medoids clustering, Bayesian Inference, Baye's classification rule, Likelihood estimation, Nearest neighbor classification, Linear discrimant analysis from Baye's classifier, perceptron

classifier, error functions, simple feed-forward neural networks, multi-layered neural networks, back propagation.

22EEXXYY	**Artificial Intelligence**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1:

Introduction to Artificial Intelligence, Intelligent Agents, State Space Search , Uninformed Search, Informed Search

Unit-2:

Two Players Games , Constraint Satisfaction, problems on Constraint Satisfaction, Knowledge Representation and Logic, Interface in Propositional Logic, First Order Logic,Reasoning Using First Order Logic

Unit-3:

Resolution in FOPL,Rule Based System,Rule Based Systems II,Semantic Net,Reasoning in Semantic Net,Frames

Unit-4:

planning: Representing change, strips planner, algorithm, mutual exclusion relation, Rule Based Expert System

Unit-5:

Reasoning with Uncertainty, certainty algebra, uncertainty and multiple rules, properties of BN.

Unit-6:

Introduction to Learning, Rule Induction and Decision Trees, Learning Using neural Networks, Probabilistic Learning, Natural Language Processing

22EEXXYY	**Digital System Design**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1: HDL for Digital System Designs

Verilog HDL modeling of Combinational circuits design: Code converters, Multiplexers, Decoders, multi-bit adders, subtractors, multipliers others. Timing control, Blocking and non-blocking assignments. Combinational Synthesis.

Unit-2: HDL for Digital System Designs

Verilog HDL modeling of Sequential circuits design: Flipflops, synchronous counters, asynchronous counters, registers. Sequential Synthesis.

Unit-3: Finite State Machines

Mealy machines, Moore machines, Conversion of mealy machines to moore machines and vice-versa. Mealy and Moore model for serial-adder. Sequence detectors (overlap and non-overlap modeling techniques). Even parity and Odd parity detectors and generators using state machines.

Unit-4: HDL for Finite State Machines

Verilog HDL modeling of Finite state machines (Mealy and Moore models), modeling of test bench.

Unit-5: Digital Systems modeling

Datapath design, controlpath design, GCD system design, Traffic light controller design, vending machine design. CPU Design and Test: SAYEH datapath and control path design

Unit-6: HDL Modeling of USB Protocol Analyzer

Design overview: State machine and subcircuit partitioning. Verilog modeling: Digital Phase-locked loop, NRZI to Binary converter, CRC Checker submodules, Packet ID recognizer, state machine subcircuit,

Top-level module, Test bench for entire circuit, Simulation resultsanalysis.

22EEXXYY	**System Design Through Verilog**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1 Introduction to Verilog:

Verilog Operators and Modules ,Verilog Ports,Data types and Assignments,Basics Of Gate Level Modelling

Unit-2 Gate Level Modelling:

Half Adder,Full Adder and Ripple Carry Adder;Parallel Adder/Subtractor;Multiplier and Comparator

Unit-3 Behavioral Modelling 1&2

Decoder ,encoder and multiplexer,Demultiplexer ,read only memory,Review of flip-flops ,Verilog Modelling of flip -flops,Modeling of CMOS gates and Boolean Functions,Modeling Using transmission gates,CMOS delay times,Signal Strengths

Unit-4 Data flow & Switch level Modelling

Basics of data flow modeling Examples of data flow modeling,Basics of behavioral modeling ,Examples of behavioral Modeling,Verilog Modeling of Counters,verilog Modeling

Unit-5 Synthesis Of Combinational logic using Verilog

Combinational circuit examples,Sequential circuits,Arithmetic and Logic Unit (ALU) Static Ram and Braun Multiplier

Unit-6 Synthesis of Sequential logic using Verilog

FIR filter implementation,Bauhg -wooley Signed Multiplier architecture,IIR filter implementation

22EEXXYY	**Microelectronics: Devices To Circuits**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Bipolar Junction Transistor : Physical structure and Modes of Operation, BJT Operation in active mode Circuit symbol and conventions, BJT as an amplifier ,small circuit model, BJT Small Signal Circuit Model, BJT as a switch and Ebers Moll Model, Simple BJT Inverter, BJT second order effects.

Unit-2

MOSFET: MOS Transistor basics, MOS Parasitic and SPICE Model, CMOS Inverter Basics, Power Analysis, Logical Efforts, Fabrication, Biasing of Amplifier and its behaviour as an Analog switch,CMOS CS/CG /CD Amplifier Configuration,Internal CAP Models and high frequency modelling.

Unit-3

JFET Structure and Operation, Multistage and Differential Amplifier, MOS Differential Amplifier, Small signal operation and Differential amplifiers,

Unit-4

Multistage amplifier with SPICE simulation, S-Domain Analysis, Transfer function, Poles and zeroes.

Unit-5

High frequency response of CS and CE amplifier, High frequency response of CC and SF configuration, Frequency response of Differential Amplifier, General Feedback Structure and properties of negative Feedback.

Unit-6

Operational amplifier as a integrator and differentiator, Large signal operation of operational amplifier and second order effects, Combinational logic design, Sequential logic design, Clocking strategies for sequential design, Memory design.

22EEXXYY	**Introduction to VLSI Design**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1 Introduction to VLSI Design

System approach to VLSI Design : What is system? , Design Abstraction Levels ,Delay and Interconnect Issues in physical circuits

Unit-2 MOSFET

Introduction to MOSFET :Basic MOS Structure,Types of MOSFET, MOSFET I-V Modeling ; MOSFET Capacitor: MOS as Capacitor ,Modes of operation,Capacitance calculation of MOS capacitor ,Threshold Voltage Calculation ,C-V characteristics , Oxide Charge Correction; MOSFET I-V characteristics: Derivation of I-V relationship ,Channel length modulation and body bias effect ; Advanced Topics: Motivation for Scaling,Types of Scaling,Velocity saturation,Short Channel Effects ;Short Channel Effects: Motivation ,Mobility degradation ,Subthreshold current ,Threshold voltage variation,Drain induced barrier lowering (DIBL),Drain punch through,Hot carrier effect,Surface states and interface trapped charge

Unit-3 Fabrication Process and Layout Design Rules

Introduction to Fabrication Process :Photolithography,Fabrication Process ; General Aspects of CMOS Technology :Gate Material ,Parasitic Capacitances,Self-aligned silicon gate technology,channel stopper and implant , polysilicon deposition,oxide Growth ,Active mask or Isolation mask (thin-ox) ,Local Oxidation of silicon (LOCOS) ; CMOS Fabrication Technologies:Twin Well/Tub Technology,Silicon on Insulator (SOI),N-well/P-well Technology ; Layout Design Rules :Types of Design Rules,Layer Representations,Stick Diagrams,Background, λ-based Design Rules.

Unit-4 Propagation Delays in MOS

CMOS Inverter Characteristics:CMOS Inverter Characteristics,Noise Margins,Regions of operation; Propagation Delay Calculation of CMOS Inverter: Definitions , Rise and Fall times Calculation ; Pseudo NMOS Inverter:Different Configurations with NMOS Inverter,Worries about Pseudo NMOS

Inverter,Calculation of Capacitive Load; Dependence of Propagation delay on Fan-in and Fan-out:Design Techniques for large ;Analyzing Delay for various Logic Circuits:Ratioed Logic,Ratioed Logic,Dynamic Logic Circuits;Analyzing Delay in few Sequential Circuits:Negative D-Latch,S-R Latch using NOR Gates,Simple Latch using two Inverters (Bistable Element),Master-Slave FF; Logical Effort Calculation of few Basic Logic Circuits:Delay in a Logical Gate,Definition of Logical Effort,Logical Effort of an Inverter ,NAND ,NOR and XOR gates,Logic Effort Calculation of few Mixed Circuits and Delay plot;Logical Effort of Multistage Logic Networks; Methods for Reduction of Delays in Mutlistage Logic Networks;Designing Asymmetric Logic Gates

Unit-5 Power Dissipation in CMOS Circuits

Effect of Power Dissipation ,How to Reduce Temperature,Components of Power Dissipation,Static Power Dissipation,Dynamic Power Dissipation,Methods to Reduce Power Dissipation,Short-Circuit Power Dissipation

22EEXXYY	**NanoElectronics: Devices and Materials**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Overview: Nano devices, Nano materials, Nano characterization,MOS Scaling theory, Issues in scaling MOS transistors : Short channel effects, Description of a typical 65 nm CMOS technology.

Unit-2

Requirements for Non classical MOS transistor,MOS capacitor, Role of interface quality and related process techniques, Gate oxide thickness scaling trend, SiO2 vs High-k gate dielectrics. Integration issues of high-k . Interface states, bulk charge, band offset, stability, reliability - Qbd high field, possible candidates, CV and IV techniques, Metal gate transistor : Motivation, requirements, Integration Issues.

Unit-3

Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot,SOI - PDSOI and FDSOI ,Ultrathin body SOI - double gate transistors, integration issues.

Unit-4

Vertical transistors - FinFET and Surround gate FET , Metal source/drain junctions - Properties of schottky junctions on Silicon, Germanium and compound semiconductors -Workfunction pinning, Germanium Nano MOSFETs : strain , quantization , Advantages of Germanium over Silicon , PMOS versus NMOS. Compound semiconductors - material properties, MESFETs Compound semicocnductors MOSFETs in the context of channel quantization and strain , Hetero structure MOSFETs exploiting novel materials, strain, quantization.

Unit-5

Synthesis of Nanomaterials : CVD, Nucleation and Growth, ALD, Epitaxy, MBE ,Compound semiconductor , Compound semiconductor hetero-structure growth and characterization : Quantum wells, Thickness measurement techniques: Contact - step height, Optical - reflectance and ellipsometry , AFM, Characterization techniques for nanomaterials: FTIR, XRD, AFM, SEM, TEM, EDAX etc & Applications and interpretation of results.

Unit-6

Emerging nano materials : Nanotubes, nanorods and other nano structures, LB technique, Soft lithography etc. Microwave assisted synthesis, Self assembly etc.

22EEXXYY	**Computer Networks**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media,

Unit-2

LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spreadspectrum.

Unit-3

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA

Unit-4

Network Layer: Switching, Logical addressing IPV4, IPV6; Address mapping ARP, RARP, BOOTP and DHCP Delivery, Forwarding and Unicast Routingprotocols.

Unit-5

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit-6

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of cryptography.

22EEXXYY	**Computer Architecture and Organization**	**PEC**	**3L: 0T: 0P**	**3 credits**

Unit-1

Architecture of 8086 microprocessor, special functions of general purpose registers,8086 flag register and function of 8086 flags, pin diagram of 8086,minimum and maximum mode of 8086 configuration and timing diagrams.Addressing modes of 8086, Instruction sets of 8086.

Unit-2

Introduction to MIPS architecture, MIPS Instruction Set Architecture, Procedures, Recursive Programs, Architecture Examples, Introduction to Assessing and Understanding Performance, CPU Performance and its Factors, Evaluating Performance, Benchmarks and the performance of recent IntelProcessors.

Unit-3

Introduction to Processor: Data path and Control, Logic design Conventions, Building a Data path, Simple Implementation scheme, Multi-cycle Implementation, Exceptions, Microprogramming: Simplifying Control Design, Introduction to Digital Design Using a Hardware Design Language.

Unit-4

Introduction to Pipelining, A pipelined Data path, Pipelined Control, Data Hazards and Forwarding, Data Hazards and Stalls, Branch Hazards, Exceptions, Advanced Pipelining.

Unit-5

Introduction to Memory Hierarchy, The Basic of Caches, Measuring and Improving Cache Performance, Virtual Memory, Common Framework for Memory Hierarchies.

Unit-6

Introduction to Storage, Networks and other Peripherals, Disk Storage and Dependability, Networks, Busses and other Connections between Processors, Memory and I/O Devices, Interfacing I/O Devices to the Processor, Memory and Operating System, I/O Performance Measures, Designing an I/O System.

Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electrical & Electronics Engineering

COURSES BEING OFFERED TO OTHER DEPARTMENTS

COURSE CODE	SUBJECT NAME	L-T-P	CREDITS	BRANCHES
22EEXX09	Basic Electrical and Electronics Engineering	X-X-X	X	MME, CE, CH, CSE, ME
22EEXX89	Basic Electrical and Electronics Engineering Laboratory	0-0-3	X	MME, CE, CH, CSE, ME

CHE: Department of Chemical Engineering
CE: Department of Civil Engineering
CSE: Department of Computer Science and Engineering
ME: Department of Mechanical Engineering
MME: Department of Metallurgy and Materials Engineering

22EEXXXX	**Basic Electrical and Electronics Engineering**	**ESC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives:

1. Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology.
2. Provide knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.
3. To explain the working principle, construction, applications of DC machines, AC machines.
4. Realize the importance of electronic devices in the present technology.

Course Content:

Unit-I **(10 Hours)**

DC Circuits

Introduction, Basic definitions, Types of elements, Ohm's Law, Kirchhoff's Laws, Series, Parallel circuits, Star-delta and delta-star transformations, equivalent resistance calculation, Mesh and Nodal analysis, superposition theorem, thevenin's theorem and maximum power transfer theorem.

Unit-II **(05 Hours)**

AC Circuits

Single-phase: Introduction to AC, RMS value, Inductive circuits, capacitive circuits, series RL, RC and RLC circuits, resonance

Three-phase: star connection and delta connection.

Unit-III **(8 Hours)**

DC Machines

Generator: Principle of operation of DC Generator, EMF equation, types, applications

Motor: DC motor types, torque equation, applications, three point starter.

UNIT-IV **(08 Hours)**

AC Machines

Transformers: Principle of operation of single phase transformers, EMF equation, losses, efficiency.

Induction Machine: Principle of operation of induction motor, slip-torque characteristics, applications.

UNIT-V **(07 Hours)**

Semiconductor Devices

Diode: types of semiconductors, P-N junction diode, V-I Characteristics, zener diode, Diode Applications. **Rectifiers:** Half wave, Full wave and Bridge rectifiers.

UNIT-VI **(07 Hours)**

Transistors

PNP and NPN Junction transistor, Transistor configurations, Transistor as an amplifier

Learning Resources

Text book

Basic Electrical and Electronics Engineering by Kothari and Nagarath, TMH Publications, 2nd Edition.

Reference Books

Principles of Electrical and Electronics Engineering by V.K.Mehta, S.Chand & Co.
Basic Electrical Engineering by Kothari and Nagarath, TMH Publications, 2nd Edition.

Web Resources

1. Prof T S Natarajan, NPTEL-IIT Madras, 'Basic Electronics'
   URL: https://nptel.ac.in/courses/122106025/
2. Prof U Umanand, IISC Bangalore, 'Basic Electrical Technology'.
   URL: http://nptel.ac.in/courses/108108076/
3. Prof S Aniruddhan, IIT Madras, 'Basic Electrical Circuits'.
   URL: https://onlinecourses.nptel.ac.in/noc16_ee03

Course Outcomes

At the end of the course, the student will be able to

CO 1	Predict the behaviour of any electrical and magnetic circuits.
CO 2	Formulate and solve complex AC, DC circuits
CO 3	Identify the type of electrical machine used for that particular application
CO 4	Realize the requirement of transformers in transmission and distribution of electric power and other applications
CO 5	Utilize the semiconductor devices like diodes and transistors
CO 6	Internlink Knowledge of electrical and electronic circuits to general problems

Assessment Method

Assessment Tool	Weekly tests/Assignments (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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22EEXXXX	**Basic Electrical and Electronics Engineering Laboratory**	**ESC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective:

- To make student get familiarized with the electrical and electronic measuring equipments
- To make understand the student the concepts of characteristics of Resistors, Capacitors and Inductors
- To understand the behaviour of electrical equipments
- To understand the concepts of diodes, transistors and amplification

List of Experiments:

Familiarization with DSO, Function generators, RPS, FPS, Multimeters and other lab equipments

Section A: Electrical Engineering Laboratory

1. Verification of ohm's law, series and parallel circuits
2. Verification of Kirchhoff's Laws
3. Verification of Voltage division and Current division principles
4. Verification of circuit theorems
5. V-I characteristics of Incandescent and CFL lamp
6. V-I characteristics of Fluorescent lamp
7. A.C analysis of series R-L circuit and R-C circuit
8. Calibration of Energy meter
9. Open circuit characteristics of D.C Generator
10. Speed control of D.C shunt Motor
11. Three phase power measurement
12. Lab project

Section B: Electronics Engineering Laboratory

1. Familiarization with any CAD tools like multisim/Pspice/ngspice for doing basic experiments
2. V-I characteristics of a P-N junction diode and zener diode
3. Half wave and center tapped full wave rectifier
4. Full wave bridge Rectifier with and without filters.
5. Design of a simple amplifier using BJT
6. Experiment on simple analog-modulation scheme
7. Simple experiment on Arduino kit and interfacing with sensors
8. Lab project

Course outcome

At the end of the course, the student will be able to

CO 1	Design basic circuits using P-N junction diode and Zener diode
CO 2	Design rectifier circuits considering the practical aspects into consideration
CO 3	Design simple amplifier with required gain
CO 4	Use circuit knowledge in analyzing Arduino boards
CO 5	Designing simple experiments using Arduino board and sensors interfacing
CO 6	Experimental verification of basic circuit laws and circuit theorems
CO 7	Experimental analysis of V-I characteristics of different electrical and electronic equipments
CO 8	Experimental analysis of electrical machines likes motors, generators etc
CO 9	Design of a simple prototype project

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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