**Department of Computer Science & Engineering**
**School of Engineering and Technology**
**H. N. B. Garhwal University, Srinagar**

5491
06/12/18

# General Meeting of Board of Studies

**VENUE** : Department of Computer Science & Engineering, Chauras Campus, H.N.B. Garhwal University, Srinagar.
**DATE** : 03rd October, 2018
**TIME** : 11:00 A.M.

## AGENDA

**Minutes of the Meeting of the Board of Studies**

Meeting of the Board of Studies of Department of Computer Science & Engineering was held on 03.10.2018 at 11.00 A.M. in the office of Head, Department of Computer Science & Engineering, HNB Garhwal University, Srinagar (Garhwal).
The meeting was attended by the following:-

1. Prof. M.M.S. Rauthan — **Chairman**
   Head, Department of Computer Science & Engineering
   HNB Garhwal University, Srinagar
2. Prof. D S. Negi, Head — **Cognate Member**
   Depart ent of Mathematics,
   HNB Garhwal University, Srinagar
3. Prof. S.C.Bhatt, — **Cognate Member**
   Department of Physics,
   HNB Garhwal University, Srinagar
4. Dr. Y.P.Raiwani — **Member**
   Department of Computer Science & Engineering
   HNB Garhwal University, Srinagar
5. Dr. M.P. Thapliyal — **Member (Special Invitee)**
   Associate Professor
   Department of Computer Science & Engineering
   HNB Garhwal University, Srinagar
6. Dr. Narender Kumar — **Member (Special Invitee)**
   Assistant Professor
   Department of Computer Science & Engineering
   HNB Garhwal University, Srinagar

The following members could not attend the meeting:-

1. Prof. V.K. Sharma — **Expert**
   Department of Computer Science
   Gurukul Kangri University, Haridwar

The Chairman welcome all the members of the Committee and items of the agenda were discussed one by one, by the committee.

**Item no. 1** ***Approval of modified syllabi of B.Tech (CSE), M.Tech (CSE) and Pre- Ph.D. Courses.***

**Resolution:** All the members of the Committee were agreed for the modification made in the syllabi. The suggestions and modification by the members were incorporated in the syllabus

**Item no. 2:** ***Approval of changes in evaluation schemes of final semesters of MCA, BCA, B.Sc. (IT), M.Sc. (IT), B.Sc. (CS) and M.Sc. (CS) as per university norms.***

**Resolution:** All the members of the Committee were agreed for the changes made in the evaluation schemes of final semester of MCA, BCA, B.Sc. (IT), M.Sc. (IT), B.Sc.(CS) and M.Sc.(CS) as per following tables:

## MCA VI Semester

| Subject Code | Subject | Instructional Hrs/Week | | | Marks | | | Credit |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | ESA | CA | Sub Total | |
| **Practical** | | | | | | | | |
| SET/CSE/MCA/PR61 | Thesis/Project Work | - | 3 | 18 | 60 | 40 | 100 | 15 |
| **Elective IX** | | | | | | | | |
| SET/CSE/MCA/E601 | Seminar | - | - | - | 60 | 40 | 100 | 3 |
| SET/CSE/MCA/E602 | Group Discussion | | | | | | | |
| **Total** | | **-** | **3** | **18** | **120** | **80** | **200** | **18** |

ESA : End Semester Assessment
CA : Continuous Assessment
Sub. Total : Subject Total

## BCA VI Semester

| S. No. | Course No. | Subject | Evaluation – Scheme | | | | | | | | Credit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Period | | | Sessional | | | Examination | | |
| | | | L | T | P | TA | CT | TOT | ESE | Sub. Total | |
| **Theory** | | | | | | | | | | | |
| 1. | SET/CSE/BCA/DSE4 | DSE4A | 4 | 1 | - | 10 | 20 | 30 | 70 | 100 | 5 |
| 2. | SET/CSE/BCA/DSE4 | DSE5A | 4 | 1 | - | 10 | 20 | 30 | 70 | 100 | 5 |
| 3. | SET/CSE/BCA/SEC4 | SEC 4A | 2 | - | - | 10 | 20 | 30 | 70 | 100 | 2 |
| **Practical** | | | | | | | | | | | |
| 1. | SET/CSE/BCA/EP61 | DSE4A Lab | - | - | 3 | 30 | - | 30 | 70 | 100 | 2 |
| 2. | SET/CSE/BCA/EP62 | Project | 2 | 2 | 6 | 30 | - | 30 | 70 | 100 | 6 |
| **Total** | | | **12** | **4** | **9** | **90** | **60** | **150** | **350** | **500** | **20** |

## B.Sc. (IT) VI Semester

| S.No | Course No. | Subject | Evaluation – Scheme | | | | | | | | Credit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Period | | | Sessional | | | Examination | | |
| | | | L | T | P | TA | CT | TOT | ESE | Sub. Total | |
| **Theory** | | | | | | | | | | | |
| 1. | SET/CSE/BIT/DSE4 | DSE4A | 4 | 1 | - | 10 | 20 | 30 | 70 | 100 | 5 |
| 2. | SET/CSE/BIT/DSE5 | DSE5A | 4 | 1 | - | 10 | 20 | 30 | 70 | 100 | 5 |
| 3. | SET/CSE/BIT/SEC4 | SEC4A | 2 | - | - | 10 | 20 | 30 | 70 | 100 | 2 |
| **Practical / Tutorial** | | | | | | | | | | | |
| 1. | SET/CSE/BIT/CP61 | DSE4A Lab | - | - | 3 | 30 | - | 30 | 70 | 100 | 2 |
| 2. | SET/CSE/BIT/CP62 | Project | 2 | 2 | 6 | 30 | - | 30 | 70 | 100 | 6 |
| | | **Total** | **12** | **4** | **9** | **90** | **60** | **150** | **350** | **500** | **20** |
| **Total Credits** | | | | | | | | | | | **120** |

## M.Sc. (IT) IV Semester

| S.No | Course No. | Subject | Evaluation – Scheme | | | | | | | | Credit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Period | | | Sessional | | | Examination | | |
| | | | L | T | P | TA | CT | TOT | ESE | Sub. Total | |
| **Theory** | | | | | | | | | | | |
| 1. | SET/CSE/MIT/E3 | Elective III | 3 | - | - | 10 | 30 | 40 | 60 | 100 | 3 |
| 2. | SET/CSE/MIT/E4 | Elective IV | 3 | - | - | 10 | 30 | 40 | 60 | 100 | 3 |
| **Practical** | | | | | | | | | | | |
| 1. | SET/CSE/MIT/EP41 | Elective III | - | - | 3 | 10 | 30 | 40 | 60 | 100 | 2 |
| 2. | SET/CSE/MIT/PR41 | Project | - | 2 | 12 | 10 | 30 | 40 | 60 | 100 | 10 |
| | | **Total** | **6** | **2** | **15** | **40** | **120** | **160** | **240** | **400** | **18** |
| 1. | SET/CSE/MIT/SS41 | Self-Study | 2 | 1 | - | - | - | - | - | - | 3 |

## B.Sc. (CS) VI Semester

| S.No | Course No. | Subject | Evaluation – Scheme | | | | | | | | Credit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Period | | | Sessional | | | Examination | | |
| | | | L | T | P | TA | CT | TOT | ESE | Sub. Total | |
| **Theory** | | | | | | | | | | | |
| **1.** | SET/CSE/BCS/DSE4 | DSE4A | 4 | 1 | - | 10 | 20 | 30 | 70 | 100 | 5 |
| **2.** | SET/CSE/BCS/DSE5 | DSE5A | 4 | 1 | - | 10 | 20 | 30 | 70 | 100 | 5 |
| **3.** | SET/CSE/BCS/SEC4 | SEC4A | 2 | - | - | 10 | 20 | 30 | 70 | 100 | 2 |
| **Practical / Tutorial** | | | | | | | | | | | |
| **1.** | SET/CSE/BCS/CP61 | DSE4A Lab | - | - | 3 | 30 | - | 30 | 70 | 100 | 2 |
| **2.** | SET/CSE/BCS/CP62 | Project | 2 | 2 | 6 | 30 | - | 30 | 70 | 100 | 6 |
| | | **Total** | **12** | **4** | **9** | **90** | **60** | **150** | **350** | **500** | **20** |

## M.Sc. (CS) IV Semester

| S. No | Course No. | Subject | Evaluation – Scheme | | | | | | | | Credit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Period | | | Sessional | | | Examination | | |
| | | | L | T | P | TA | CT | TOT | ESE | Sub. Total | |
| **Theory** | | | | | | | | | | | |
| **1.** | SET/CSE/MCS/E3 | Elective III | 3 | - | - | 10 | 30 | 40 | 60 | 100 | 3 |
| **2.** | SET/CSE/MCS/E4 | Elective IV | 3 | - | - | 10 | 30 | 40 | 60 | 100 | 3 |
| **Practical** | | | | | | | | | | | |
| **1.** | SET/CSE/MCS/EP41 | Elective III | - | - | 3 | 40 | - | 40 | 60 | 100 | 2 |
| **2.** | SET/CSE/MCS/PR41 | Project | - | 2 | 12 | 40 | - | 40 | 60 | 100 | 10 |
| | | **Total** | **6** | **2** | **15** | **100** | **60** | **160** | **240** | **400** | **18** |
| **1.** | SET/CSE/MCS/SS41 | Self-Study | 2 | 1 | - | - | - | - | - | - | 3 |

**Item no. 3:** ***Approval of allotment of Supervisors for Research Scholar***

**Resolution:** The research scholar of computer science and application session 2017-18 has qualified Pre-Ph.D. Examination. The Allotment of supervisors for Ph.D. program for them was done as per the following table:

| S.No. | Name of the Research Scholar | Name of Supervisor |
|---|---|---|
| **1.** | Mr. Varun Barthwal | Prof. M. M. S. Rauthan |
| **2.** | Mr. Shailesh Singh Panwar | Dr. Y.P. Raiwani |
| **3.** | Ms. Khushbu Verma | Dr. Narendra Kumar Rawal |

**Item No. 4:** ***Discussion on leave application of Ms. Neelam Panwar (Research Scholar, Enrollment no. G151901, Registration no. ECS -16187, Registration Date 09.07.2015).***

**Resolution:** Ms. Neelam Panwar has completed minimum required period of 24 months in the campus after Pre-Ph.D. course. She is eligible to carry her research work off campus according to Ph.D. ordinance 2012 clause 9(A).So all the members of the Committee were agreed to accept her request for leave in anticipation of the approval of Hon'ble Vice- Chancellor.

**Item No. 5:** ***Approval for Admission to MCA II$^{nd}$ year (Lateral Entry) against vacancies of first year from academic session 2019-20.***

**Resolution:** As per AICTE F.NO. AICTE/AB/NR/MCA-L.E./2016 dated 14.10.2016, all the members of the committee are agreed for MCA second year Lateral Entry with following conditions

*"Provided that Students who have completed Bachelor's Degree of minimum 03 years duration in BCA, B.Sc. (Information Technology)B.Sc. (Computer Science) with Mathematics as a course at 10+2 level or at Graduate level shall be eligible for admission to second year MCA courses up to a maximum of 20% of sanctioned intake (30% for Institutions in Andaman, Nicobar, Lakshadweep, Daman and Diu) plus unfilled vacancies of 1$^{st}$year which shall be over and above, supernumerary of the sanctioned intake."*

**Item No. 6:** ***Approval of entrance test syllabi of MCA 2 year (Lateral Entry) and 3 year - Programme, M.Tech and PhD. Entrance examination.***

**Resolution:** All the members of the Committee discussed the syllabi and approved the syllabi. of entrance test.

| | | | |
|---|---|---|---|
| (Prof. M.M.S. Rauthan)<br>Chairman | (Prof. D.S. Negi)<br>Cognate Member | (Prof. S. C. Bhatt)<br>Cognate Member | (Dr. Y. P. Raiwani)<br>Member |

| | |
|---|---|
| (Dr. M. P. Thapliyal)<br>Member | (Dr. Narender Kumar )<br>Member |

Hon'ble VC

May kindly approve the minutes of the BOS meeting.

Approved
17.12.2018
Hon'ble VC

For approval and
records.
6/12

# Department of Computer Science & Engineering
# School of Engineering and Technology
# H. N. B. Garhwal University, Srinagar

1924
13/05/2020

## General Meeting of Board of Studies

**VENUE** : Department of Computer Science & Engineering, Chauras Campus, H.N.B. Garhwal University, Srinagar.

**DATE** : 04th March, 2020

**TIME** : 11:00 A.M.

कुलसचिव कार्यालय
सं० 1328
दि० 13/5/2020

## AGENDA

**Minutes of the Meeting of the Board of Studies**

Meeting of the Board of Studies of Department of Computer Science & Engineering was held on 04.03.2020 at 11.00 A.M. in the office of Head, Department of Computer Science & Engineering, HNB Garhwal University, Srinagar (Garhwal).
The meeting was attended by the following:-

| | | |
|---|---|---|
| 1 | Prof. M.M.S. Rauthan<br>Head, Department of Computer Science & Engineering<br>HNB Garhwal University, Srinagar | **Chairman** |
| 2 | Prof. R. K. Sharma, Dept. of Computer Science & Engineering, Thapar Institute of Engineering & Technology (Deemed to be University) | **Expert** |
| 3. | Prof. N. S. Panwar, Department of USIC<br>HNB Garhwal University, Srinagar | **Cognate Member** |
| 4. | Prof. Y.P.Raiwani, Department of Computer Science & Engineering, HNB Garhwal University, Srinagar | **Dean, SOET** |
| 5. | Prof. M.P. Thapliyal, Department of Computer Science & Engineering HNB Garhwal University, Srinagar | **Member** |
| 6 | Dr. Narender Kumar, Assistant Professor<br>Department of Computer Science & Engineering<br>HNB Garhwal University, Srinagar | **Member** |

Prof. Durgesh Pant (expert) and Prof. D.S. Negi (Cognate member) could not attend the meeting due to their prior assignments.

The Chairman welcomed all the members of the Committee and items of the agenda were discussed one by one, by the committee.

**Item no. 1:** Confirmation of minutes of the BOS held on 11/09/2019 (Annexure -I).

**Resolution:** It was resolved to confirm the minutes of the BOS held on 11/09/2019.

**Item no. 2:** Approval of experts for forthcoming academic activities.

**Resolution:** The committee resolved that the chairman of the BOS is authorized to send the list of experts for selection/other academic activities.

**Item no. 3:** Approval of the six month progress report (Jul - Dec 2019) of Mr. Varun Barthwal, research scholar, Computer Science and Application (Registration no: ECS-17100) (Annexure -II).

**Resolution:** Mr. Varun Barthwal presented his work to the committee members. His progress of work is satisfactory. He has submitted one paper to an SCI journal. It is suggested that he should work for some more SCI journal publications.

**Item no. 4:** Approval of the six month progress report (Jul - Dec 2019) of Mr. Shailesh Singh Panwar, research scholar, Computer Science and Application (Registration no: ECS-17101) (Annexure -III).

**Resolution:** Mr. Shailesh Singh Panwar presented his work to the committee members. He is working on an ML problem. His progress of work is also satisfactory. It is suggested that he may include deep learning approach in his work.

**Item no. 5:** Approval of the six month progress report (Jul - Dec 2019) of Ms. Khushbu Verma, research scholar, Computer Science and Application (Registration no: ECS-17102) (Annexure -IV).

**Resolution:** Ms. Khushbu Verma presented her work to committee members. It is suggested that Ms. Khusbu should focus more on her work. It is also suggested that she publishes her work in a reputed journal.

**Item no. 6:** Constitution of the Departmental Academic Integrity Panel (DAIP) as per UGC letter D.O. No. F.1-18/2010 (CPP-II) dated 06/08/2018 (Annexure -V).

**Resolution:** Following Departmental Academic Integrity Panel (DAIP) has been constituted by the committee.

1. Head, Dept of CSE — Chairman
2. Prof. N. S. Panwar, Senior academician outside the department — Member
   *(Nominated by Hon'ble Vice-Chancellor)*
3. Prof. Y. P. Raiwani — Member
   *(Nominated by Head of Department)*

**Item no. 7:** Inclusion of subject "Research and Publication Ethics (RPE)" as two credit compulsory paper in the Pre-PhD course as per UGC letter D.O. No. F.1-1/2018 (Journal/CARE) (Annexure -V).

**Resolution:** As per the decision of convener, Ordinance committee, two credit course in "Research and Publication Ethics (RPE)" has been included as part 'A' of core course. Also BOS has decided to include "Technical Writing using Latex" as one credit course.

**Item no. 8:** Approval of syllabus of the subject Research and Publication Ethics (RPE) as per UGC letter D.O. No. F.1-1/2018 (Journal/CARE).

**Resolution:** All the committee members have approved the syllabus (Annexure-VI) "Research and Publication Ethics (RPE)".

**Item no. 9:** To introduce one online MOOC course from SWAYAM portal.

**Resolution:** All the committee members approved online MOOC course on following areas:

- Problem solving Aspects and Python Programming
- Animations
- Data Science for Engineers
- Deep Learning
- Google cloud computing foundation course
- Introduction to Internet of Things

**Item no. 10:** To offer specialization in existing M.Tech (CSE) core and Information security (Annexure-VII).

**Resolution:** All the committee members have approved specialization in the following subjects

(i) M.Tech (CSE) core

(ii) M.Tech (CSE) Information security in previously approved seats.

**Item no. 11:** Interview of qualified candidates of Ph.D. entrance examination (2019) and exempted category candidates in Computer Science and Applications.

**Resolution:** In all thirteen candidates (Seven qualified candidates of Ph.D. entrance examination 2019 and Six are from exempted category) selected for the interview for selection in Pre-Ph.D. Course in Computer Science and Applications for session 2019-20. Number of candidates who have attended the interview was Five (Four qualified candidates of Ph.D. entrance examination 2019 and one is from exempted category). The BOS unanimously selected the following candidates in order of merit in their respective categories.

***General category***

1. Mr. Suraj Singh Panwar
2. Mrs. Shail Ratna Bhatt

***SC Category***

1. Mr. Kuldeep Singh

***OBC Category***

1. None found suitable

***EWS Category***

1. No Candidate appeared in this category

(Prof. R. K. Sharma)
Expert

(Prof. M.M.S. Rauthan)
Chairman

(Prof. N.S. Panwar)
Cognate Member

(Prof. Y. P. Raiwani)
Member

(Prof. M. P. Thapliyal)
Member

(Dr. Narender Kumar)
Member

Hon'ble VC

May kindly approve the minutes.

Date

पाठ्यक्रम समिति कश्मीर घाटी एवं जम्मू-जी० की बैठक दिनांक 4-3-2020 में लिए गये निर्णयों में मद सं० 01 से मद सं० 09 एवं मद सं० 11 BoS से संबंधित है। मद सं० 10 स्कूल बोर्ड से रखा जाना है।

अतः यथादेय कुलपति जी के अनुमोदनार्थ प्रेषित।

6/6/20

5/6/2020
SO (Acad)

DR(A)

Agenda item no. 6 to 10 needs approval of School Board.

BOS minutes are submitted for kind consideration and approval please.

6/6/20

Registrar 10.06.2020

Hon'ble VC

12.6.2020

**Department of Computer Science & Engineering**
**School of Engineering and Technology**
**H. N. B. Garhwal University, Srinagar**

## General Meeting of Board of Studies

| | | |
|---|---|---|
| **VENUE** | : | Department of Computer Science & Engineering, Chauras Campus, H.N.B. Garhwal University, Srinagar/Zoom App. |
| **DATE** | : | 04th July, 2020 |
| **TIME** | : | 11:00 A.M. |

## AGENDA

**Minutes of the Meeting of the Board of Studies**

Meeting of the Board of Studies of Department of Computer Science & Engineering was held through ZOOM app with meeting ID 71255823405 on 04.07.2020 at 04.00 P.M. onwards.

The online BOS meeting was attended by the following:

| | | |
|---|---|---|
| 1. | Prof. M.M.S. Rauthan<br>Head, Department of Computer Science & Engineering<br>HNB Garhwal University, Srinagar | **Chairman** |
| 2. | Prof. Durgesh Pant, School of Computer Sciences & Information Technology, Uttarakhand Open University | **Expert** |
| 3. | Prof. R. K. Sharma, Dept. of Computer Science & Engineering, Thapar Institute of Engineering & Technology (Deemed to be University) | **Expert** |
| 4. | Prof. N. S. Panwar, Department of USIC<br>HNB Garhwal University, Srinagar | **Cognate Member** |
| 5. | Prof. R. C. Dimri, Department of Mathematics,<br>HNB Garhwal University, | **Cognate Member** |
| 6. | Prof. Y. P. Raiwani, Department of Computer Science & Engineering, HNB Garhwal University, Srinagar | **Dean, SOET** |
| 7. | Prof. M.P. Thapliyal, Department of Computer Science & Engineering HNB Garhwal University, Srinagar | **Member** |
| 8. | Dr. Narender Kumar, Assistant Professor<br>Department of Computer Science & Engineering<br>HNB Garhwal University, Srinagar | **Member** |

The Chairman welcomes all the members of the Committee and items of the agenda were discussed one by one, by the committee.

**Item no. 1** : Confirmation of minutes of the BOS held on 04/03/2020.

**Resolution** : It was resolved to confirm the minutes of the BOS held on 04/03/2020.

**Item no. 2** : AICTE has approved the duration of MCA programme for 2 years from the session 2020-21 onwards ***(as per F. No. AICTE/AB/MCA/20-21 dated 03.07.2020 and approval of UGC meeting 545 held on 19.12.2019)***. It is proposed to consider the implementation of this decision in the MCA course run by Department of Computer Science and Engineering from the session 2020-21.

**Resolution** : All committee members were agreed to approve the 2 years MCA program as proposed. Moreover, it is decided by the committee that it will be implemented from the session 2020-21 onwards.

**Item no. 3** : Approval of syllabus of 2 year full time MCA programme.

**Resolution** : All committee members were agreed with content of the attached syllabus (Annexure-I) and approved the syllabi. However the Chairmen of the BOS has been authorized for minor modification as suggested by expert.

**Item no. 4** : Approval of the syllabus of Bridge Course only for the students passed B.Sc./ B.Com. / B.A. with Mathematics at 10+2 level or at Graduation Level and taking admission in 2 year fulltime MCA course.

**Resolution** : All committee members were agreed with content of the attached syllabus (Annexure-II) and approved the syllabi.

**Item no. 5** : Consideration of introducing online MOOC courses from SWAYAM/NPTEL.

**Resolution** : The committee members were agreed to introduce following MOOC courses from SWYAM/NPTEL.

- Programming, Data Structures and Algorithms using Python
- Data Science for Engineers
- Python for Data Science
- Data Analytics with Python
- Deep Learning for Computer Vision
- Introduction to Industry 4.0 and industrial Internet of Things
- Social Networks
- Privacy and Security in Online Social Media
- Introduction to Blockchain Technology and Applications
- Information Security - 5 - Secure Systems Engineering
- User-centric Computing for Human-Computer Interaction
- Applied Natural Language Processing

A student may opt only two subjects during the entire course subject to the condition that the subject is run by SWAYAM/NPTEL

**Item no. 6** : Consideration on the application of Ms. Neelam Panwar, Research Scholar (registration no. ECS-16187), requesting for six month extension for submitting the Ph.D. thesis as she could not submit her thesis due to COVID-19 an subsequent lockdown .

**Resolution** : As per the agenda no. 7 and its resolution of Academic Council Meeting held on dated 20 May 2020 the BOS recommends that the extension of six month period may be granted to Ms. Neelam Panwar, Research Scholar (registration no. ECS -16187).

Attended through ZOOM App.

| (Prof. R. K. Sharma) | (Prof. Durgesh Pant) | (Prof. N.S. Panwar) | (Prof. R.C. Dimri) |
|---|---|---|---|
| Expert | Expert | Cognate Member | Cognate Member |

| (Prof. Y. P. Raiwani) | (Prof. M. P. Thapliyal) | (Dr. Narender Kumar) | (Prof. M.M.S. Rauthan) |
|---|---|---|---|
| Member | Member | Member | Chairman |

Date

~~रेखांकित~~

पाठ्यक्रम समिति की बैठक दिनांक 4-7-2020 के लिये जो भी मद कृ0वि0 001 से 07 तक BOS से संस्तुत होकर School Board में रखा जाना है

अतः माननीय कुलपति जी के अनुमोदनार्थ प्रस्तुत।

8/7/20

8/7/2020
S.O (Acad)

DR (Acad)

Agenda items no. 2, 3, 4, 5 needs approval of School Board.

Minutes of B.O.S. are submitted for kind consideration and approval please.

9/7/20

15.7.2020

Registrar

Hon'ble VC

Approved as Proposed
17.7.2020

**Department of Computer Science & Engineering**
**School of Engineering and Technology**
**H. N. B. Garhwal University, Srinagar**

969.
31/12/2020
07/01/2021

## General Meeting of Board of Studies

**VENUE** : Department of Computer Science & Engineering, Chauras Campus, H.N.B. Garhwal University, Srinagar/Zoom App.

**DATE** : 28th December, 2020

**TIME** : 11:00 A.M.

## AGENDA

**Minutes of the Meeting of the Board of Studies**

Meeting of the Board of Studies of Department of Computer Science & Engineering was held through ZOOM app with **meeting ID 882 4004 8773** on **28.12.2020 at 11.00 A.M.**

The online BOS meeting was attended by the following:

1. Prof. M.M.S. Rauthan — **Chairman**
   Head. Department of Computer Science & Engineering
   HNB Garhwal University, Srinagar
2. Prof. H. S. Dhami, Ex Vice- Chancellor Kumon University, and Ex Vice-Chancellor, Uttarakhand Residential School of Computer Sciences & Information Technology, Uttarakhand Open University — **Expert**
3. Prof. K. S. Vaishla, Dept. of Computer Science & Engineering, Bipin Tripahti Kumon Institute of Technology, Dwarahat. — **Expert**
4. Prof. R. C. Dimri, Department of Mathematics, HNB Garhwal University, — **Cognate Member**
5. Prof. Y. P. Raiwani, Department of Computer Science & Engineering, HNB Garhwal University, Srinagar — **Member**
6. Prof. M.P. Thapliyal, Department of Computer Science & Engineering HNB Garhwal University, Srinagar — **Member**
7. Dr. Narender Kumar, Assistant Professor — **Member**
   Department of Computer Science & Engineering
   HNB Garhwal University, Srinagar

**Prof. N. S. Panwar (Cognate Member) could not attend the meeting**

The Chairman welcome all the members of the Committee and items of the agenda were discussed one by one. by the committee.

**Item no 1:** Confirmation of minutes of the BOS held on 03/11/2020.

**Resolution:** Minutes of BOS meeting held on 03/11/2020 were confirmed.

**Item no 2:** Compliance of the agenda item 27 of academic council meeting held on 10th October 2020 for approval of thirty (30) experts.

**Resolution:** As per the resolution passed in agenda item no 27 in AC meeting held on 10th October, 2020 out of 30 experts, names of at least 10 experts should be from well established university/educational institution of pan India (other than Uttarakhand state) and 10 experts from well – established University/educational institution of other countries.
The members discussed the agenda item in details and arrived at a conclusion that the members of BOS will submit the list of experts which will be finalized by convener of the BOS and Dean SOET after removing the duplicate names and including the rest of names if necessary. Based on this list of thirty subject experts for Ph.D. thesis evaluation has been finalized and sent to the Dean SOET, with a request to approve it in the next School Board meeting.

**Item no 3:** The annual/sixth month progress report of research scholar of the department.

**Resolution:** All the committee members were satisfied with the annual progress reports of Ms. Neelam Panwar, research scholar (registration no. ECS-16187) for 2017-18 & 2019-20 and approved the annual progress reports submitted by Ms. Neelam Panwar.

**Item no 3:** Approval of allotment of supervisors for research scholars of the batch 2018-19.

**Resolution:** The research scholars of Computer Science and Application for the session 2018-19 have qualified their Pre-Ph.D. examination. The allotment of supervisors for Ph.D. program for them was done as follows:

| S. No. | Name of the Research Scholar | Name of Supervisor |
|---|---|---|
| 1. | Ms. Rajeshwari Sissodia | Prof. M. M. S. Rauthan |
| 2. | Ms. Kanchan Naithani | Prof. Y. P. Raiwani |

**Item no 4** Minor changes in the syllabus of (B.Tech, Computer Science and Engineering) to cope up with the industrial requirements.

**Resolution:** All the committee members approved the syllabus B.Tech after minor modification and the suggestions of the experts have been included. The revised syllabus is enclosed as an annexure.

Attended Through ZOOM

(Prof. H. S. Dhami)
Expert

(Prof. K. S. Vaishla)
Expert

(Prof. N.S. Panwar)
Cognate Member

Attended Through ZOOM

(Prof. R.C. Dimri)
Cognate Member

(Prof. Y. P. Raiwani)
Member

Attended Through ZOOM

(Prof. M. P. Thapliyal)
Member

(Dr. Narender Kumar)
Member

(Prof. M.M.S. Rauthan)
Chairman

Hon'ble VC

May kindly approve the minutes of BOS meeting.

DR Academics
for comments
1.1.2021

Pl. examine.
4/1/21
SO(Academic)

Approved as proposed
8.1.2021

पाठ्यक्रम समिति कम्प्यूटर साइंस एवं इलै० की बैठक दिनांक 20-12-2020 में मद सं०- 02 को छोड़कर मद सं०-01, 03 को BOS द्वारा, संस्तुत है तथा मद सं०-4 को स्कूल बोर्ड में रखा जाना है।

अतः माननीय कुलपति महोदय जी के अनुमोदनार्थ प्रस्तुत।

DR(Acad) 4-1-2021

Agenda item no. 2 & 4 needs approval of School Board.

Agenda items no. 1 & 3 may be considered for kind approval please.

4/1/21

Registrar 6/01/21

मा० कुलपति:

Approved as proposed

6.1.2021

**ceedings of the BoS of the Electronics and Communication Engineering**

(Meeting held on 05-04-2018)

As per university notification No.: Acad./2018/71....., the Board of Studies (BoS) meeting was held in the office of the Head, Electronics and Communication Engineering Department at the Chauras campus of the university. Following members were present-

| | |
|---|---|
| 1. Prof. Y.Singh, ECE Dept.,GBPIET, Pauri Garhwal | Member |
| 2. Dr. P.K.Pal, ECE Dept.,NIT Srinagar Garhwal | Member |
| 3. Prof. S. C. Bhatt, Physics Dept., HNB Garhwal University | Member |
| 4.Prof.Y.S.Farswan,Dept. of History and Archaeology | Member |
| 5.Mr. A.S.Bahuguna, ECE Dept., HNB Garhwal University | Member |
| 6. Mr. Kuldip Kumar,ECE Dept., HNB Garhwal University | Convener |

The following agenda were discussed, elaborated and worked out and resolved as stated.

**Agenda item No. 1.** To identify the Experts for the Selection Committee(s) for the Electronics and Communication Engineering Department.

**Resolution:** The identified experts for Selection Committee(s) for the recruitment of Electronics and Communication Engineering Department teachers are listed in **Enclosure-1 (Envelop-1).**

**Agenda item No. 2.** To list the names of paper setters/ practical examiners for the examinations of the courses of the department.

**Resolution:** The names of the paper setters/ practical examiners for the examination of the courses of the department are as listed in **Enclosure-2 (Envelop-2).**

**Proceedings of Meeting of Board of Studies of the Dept. of Electronics and Communication Engineering** held on 26-02-2019

As per university notification No. **ACAD/2019/357** , the Board of Studies (BoS) meeting was held in office of the Head, Dept. of Electronics and Communication Engineering at Chauras Campus. Following members were present:-

1. Prof. S.C.Bhatt, Department of Physics, HNB Garhwal University, Srinagar (Garhwal).
2. Prof. Y. S.Farswan, Department of Histroy & Archaeology, HNB Garhwal University, Srinagar (Garhwal).
3. Mr. Kuldip Kumar, Assistant Professor, Department of Electronics and Communication Engineering, HNBGU, Srinagar (Garhwal).
4. Y. P. Pundir, Head, Department of Electronics and Communication Engineering, HNBGU, Srinagar (Garhwal).

However, BoS Members Prof. Y. Singh (ECE Dept. GBPEC, Ghurdauri, Pauri) and Dr. Pankaj K. Pal (Electronics Engg. Dept., NIT Uttarakhand) could not attend the meeting.

The following agenda was discussed, elaborately worked out and resolved as stated below.

**Agenda Item No. 1.** To update intake capacity and seat distribution for admission to first semester of B. Tech. in Electronics and Communication Engineering (ECE) course/ program after providing reservation for Economic Weaker Section (EWS) as per MHRD vide letter F. No. 19-3/2019-CU.Cdn dated 18-01-2019, and university letter no. , HNBGU/ DSW/2019 dated 04/02/2019.

**Resolution:** The total number of seats and the new seat distribution was calculated and updated as in Enclosure-1.

The meeting was concluded.

The item wise resolution is being recommended for the kind consideration and approval of the academics council.

(Prof. Y. S. Farswan) (Prof. S. C. Bhatt) (Mr. Kuldip Kumar)

26/02/2019

(Y. P. Pundir)

Yogendra Pratap Pundir
Asstt Professor & HOD
Dept. of Electronics and
Communication Engineering

**Proceedings of Meeting of Board of Studies of the Dept. of Electronics and Communication Engineering** held on 09-09-2019

As per university notification No. Acadmic /2019/975 , the Board of Studies (BoS) meeting was held in office of the Head, Dept. of Electronics and Communication Engineering at Chauras Campus. Following members were present:-

1. Prof. Y. Singh, Dept. of Electronics and Communication Engineering, GBPIET, Ghurdauri, Pauri Garhwal, Uttarakhand.
2. Prof. R. C. Dimri, Department of Mathematics, HNB Garhwal University, Srinagar (Garhwal).
3. Prof. D. S. Negi, Department of Mathematics, HNB Garhwal University, Srinagar (Garhwal).
4. Mr. Arun S. Bahuguna, Assistant Professor, Department of Electronics and Communication Engineering, HNBGU, Srinagar (Garhwal).
5. Y. P. Pundir, Head, Department of Electronics and Communication Engineering, HNBGU, Srinagar (Garhwal).

However, BoS Member Dr. Pankaj K. Pal (Electronics Engg. Dept., NIT Uttarakhand) could not attend the meeting. The following agenda was discussed, elaborately worked out and resolved as stated below.

**Agenda Item No. 1.** To decide and recommend Course objectives, Program Outcomes and Program Specific Outcomes for B. Tech. (ECE).
**Resolution:** The Course Objectives, Program Outcomes and Program Specific Outcomes for B. Tech. (ECE) are discussed and prepared as enclosed in enclosure-1.

**Agenda Item No. 2.** To identify and recommend experts for nomination in various committee(s) of Electronics and Communication Engineering.
**Resolution:** The experts for nomination to various committee(s) of Electronics and Communication Engineering are identified and listed in enclosure-2 (Envelop-1)

**Agenda Item No. 3.** To discuss the relevant suggestions on curriculum as obtained in feedback by students.
**Resolution:** Feedback received from students was discussed. It is decided that the curriculum does not need any modifications.

The meeting was concluded.

The item wise resolution is being recommended for the kind consideration and approval of the academics council.

(Prof. Y. Singh) (Prof. D. S. Negi) (Prof. R. C. Dimri)

(Mr. A. S. Bahuguna) (Y. P. Pundir) 9/9/2019

**Proceedings of the BoS of the Instrumentation Engineering-USIC**
(Meeting held on 05-04-2018)

As per university notification No.: Academic/2018/72, dated 02-04-2018, the Board of Studies (BoS) meeting was held in the office of the Head, **Instrumentation Engineering-USIC** at the Chauras campus of the university. Following members were present-

1. Dr. M. K. Panda, Electrical Engg. Dept.,
G B Pant Institute of Engineering and Technology, Pauri -Member

2. Prof. S. C. Bhatt, Physics Dept., HNB Garhwal University -Member

3. Prof. M. M. S. Rauthan, CSE Dept., HNB Garhwal University -Member

4. Mr. Vishal Rohilla, Asst. Professor, Instrumentation Engg.-USIC -Member

5. Prof. N.S. Panwar, Head, Instrumentation Engg.-USIC -Convener

The following agenda were discussed, elaborated and worked out and resolved as stated.

**Agenda item No. 1.** Confirmation of the Minutes of the previous BoS meeting, held on 30-01-2016.

**Resolution:** Minutes of the BoS meeting, held on 30-01-2016 were confirmed.

**Agenda item No. 2.** Change of the name of the course at B. Tech. level from **Instrumentation Engineering** course to **Electrical and Instrumentation Engineering** (EIE).

**Resolution:** To make the Instrumentation Engineering course more popular and attractive to the students seeking admission in the Engineering courses, it is decided that the name of the **Instrumentation Engineering** course at B. Tech. level be changed to **Electrical and Instrumentation Engineering** (EIE). This new nomenclature is also consistent with the nomenclature(s) recognized by the AICTE. Syllabus of the **Electrical and Instrumentation Engineering** (EIE) course is designed accordingly.

**Agenda item No. 3.** To identify the **Experts for the Selection Committee(s)** for the Instrumentation Engineering (IE) Department- USIC.

**Resolution:** The identified experts for Selection Committee(s) for the recruitment of teachers in the Instrumentation Engineering (IE) Department and University Science Instrumentation Centre (USIC) are listed in **Enclosure-1 (Envelop-1)**.

**Agenda item No. 4.** To list the names of paper setters/ practical examiners for the examinations of the courses of the department.

**Resolution:** The names of the paper setters/ practical examiners for the examination of the courses of the department are as listed in **Enclosure-2 (Envelop-2)**.

**Agenda item No. 5.** To frame the Entrance Test syllabus for Lateral entry in B. Tech. Courses.

**Resolution:** The syllabi have been made according to the diploma, and B.Sc. (Maths, Physics) standard for Lateral entry in B. Tech. Courses. The syllabi are designed and enclosed as **Enclosure-3(i) and 3(ii)** respectively.

**Agenda item No. 6.** To design the syllabus for **B. Tech. (Electrical and Instrumentation Engineering)** course.

**Resolution:** Syllabus for **B. Tech. (Electrical and Instrumentation Engineering)** course was discussed deliberately and designed as **Enclosure-4**.

The meeting was concluded with vote of thanks to the convener.

The item wise resolutions are being recommended for the kind consideration and approval of the School Board/Academics Council.

5.4.2018
Dr. M. K. Panda

Mr. Vishal Rohilla

Prof. S. C. Bhatt

Prof. M. M. S. Rauthan

05-04-2018
Prof. N.S. Panwar
(Convener)

Hon'ble Vice-chancellor
may kindly approve.
05.04.2018

Except item No. 2
rest of the agenda &
the minutes approved
11.4.2018
Hon'ble VC

Agenda No. 2 may be
need deliberation.
All other agenda + resolution
may be approved.
14/4

P. T. O.

Joint Registrar (Acad.)/ Hon'ble Vice-chancellor.

The name of the department is not being changed. Only the name of the course at B. Tech. Level is being proposed to change, as per the resolution of the Agenda Item No. 2 of the BOS Proceedings (meeting held on 05-04-2018). So there will be no need to amend the name of the departments included in the School of Engineering and Technology (including the Instrumentation Engineering department). Hence, no further deliberations will be needed.

Submitted to accord your kind approval, please, of the Agenda Item No. 2 also.

11.04-2018
Convener BOS
&
Dean SET
School of Engineering and Technology
H.N.B. Garhwal University
(A Central University)
Srinagar (Garhwal) 246174

We may consider to approve agenda-02. The matter may be reported before school board & the

12/4

Hon'ble

Approved

12.4.2018

# Curriculum and Syllabus

## B. TECH.

## Electrical and Instrumentation Engineering

(Applicable for 2018-19 batch and onwards)

**Department of Instrumentation Engineering**
**School of Engineering and Technology,**
**H. N. B. Garhwal University,**
**Srinagar Garhwal, Uttarakhand- 246174**

# Curriculum

**Definitions/ Descriptions**

1. **Credit Equivalent**

| | No. of Contact Hours per Week | Equivalent Credits |
|---|---|---|
| **Lecture+ Tutorial** | **4/3** | **3** |
| **Practical** | **2** | **1** |

***Mandatory Induction Program**

| **3 weeks duration** |
|---|
| • *Physical activity*<br>• *Creative Arts*<br>• *Universal Human Values*<br>• *Literary*<br>• *Proficiency Modules*<br>• *Lectures by Eminent People*<br>• *Visits to local Areas*<br>• *Familiarization to Dept./Branch & Innovations* |

***Induction program for students to be offered right at the start of the first year. Appendix –I sheet has attached for details.**

2. **Code for Courses:**

Code for a course consists of two alphabets followed by three digits and an optional alphabet.

- First three alphabets represent the school name (SET: School of Engineering and Technology).
- Next two alphabets in the code represent the subject area of the course. E.g. (SH: Applied Science and Humanities, EC: Electronics and Communication Engineering, EI: Electrical and Instrumentation Engineering, EE: Electrical Engineering, ME: Mechanical Engineering, CS: Computer Science and Engineering, IT: Information Technology, AECC: Ability Enhancement Compulsory Courses, HS: Humanities and Social Sciences including Management courses, MC: Mandatory Course).
- Then there will be subject code with 4 letters out of which first will tell the nature of subject (C: Core/E: Elective/S: Skill Enhancement/M: Mandatory Course/H: Humanities/A: Applied Science) and next three letters will tell the number according to the semester(for example 801 will tell its 8$^{th}$ semester subject). First digit represents the semester. Next two digits represent the sequence number of course in the list of courses of a semester.

**Elective Course:**

Elective courses are provided in V, VI, VII and VIII semesters to provide student with flexibility to choose courses of their interest from a list of offered electives. These Electives are the courses offered by the same department or other departments for the students.

## Semester-wise list of subjects

### Semester I

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C101 | Mathematics I | 3 | 1 | - | 4 | 3 |
| 2 | SET/SH/BT/C102 | Physics | 3 | 1 | - | 4 | 3 |
| | SET/SH/BT/C203 | Chemistry | | | | | |
| 3 | SET/EE/BT/C103 | Basic Electrical Engineering | 3 | 1 | - | 4 | 3 |
| | SET/ME/BT/C202 | Basic Mechanical Engineering | | | | | |
| 4 | SET/EC/BT/C104 | Basic Electronics | 3 | 1 | - | 4 | 3 |
| | SET/ME/BT/C204 | Engineering Mechanics | | | | | |
| 5 | SET/IT/BT/C105 | Fundamentals of Information Technology | 3 | 1 | - | 4 | 3 |
| | SET/CS/BT/C205 | Computer Programming | | | | | |
| 6 | AECC106 | *Environmental Science | 2 | - | - | 2 | 2 |
| 7 | SET/SH/BT/C106 | Physics Lab | - | - | 2 | 2 | 1 |
| | SET/SH/BT/C207 | Chemistry Lab | | | | | |
| 8 | SET/EE/BT/C107 | Basic Electrical Engineering Lab | - | - | 2 | 2 | 1 |
| | SET/ME/BT/C206 | Basic Mechanical Engineering Lab | | | | | |
| 9 | SET/IT/BT/C108 | Information Technology Lab | - | - | 2 | 2 | 1 |
| | SET/CS/BT/C208 | Computer Programming Lab | | | | | |
| 10 | SET/ME/BT/S109 | **Engineering Graphics | - | - | 4 | 4 | 2 |
| **Total** | | | 17 | 5 | 10 | 32 | 22 |

* Ability Enhancement Compulsory course.

*Induction program for students to be offered right at the start of the first year.

**Skill Enhancement Course.

### Semester II

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C201 | Mathematics II | 3 | 1 | - | 4 | 3 |
| 2 | SET/ME/BT/C202 | Basic Mechanical Engineering | 3 | 1 | - | 4 | 3 |
| | SET/EE/BT/C103 | Basic Electrical Engineering | | | | | |
| 3 | SET/SH/BT/C203 | Chemistry | 3 | 1 | - | 4 | 3 |
| | SET/SH/BT/C102 | Physics | | | | | |
| 4 | SET/ME/BT/C204 | Engineering Mechanics | 3 | 1 | - | 4 | 3 |
| | SET/EC/BT/C104 | Basic Electronics | | | | | |
| 5 | SET/CS/BT/C205 | Computer Programming | 3 | 1 | - | 4 | 3 |
| | SET/IT/BT/C105 | Fundamentals of Information Technology | | | | | |
| 6 | AECC206 | *General English | 2 | - | - | 2 | 2 |
| 7 | SET/ME/BT/C206 | Basic Mechanical Engineering Lab | - | - | 2 | 2 | 1 |
| | SET/EE/BT/C107 | Basic Electrical Engineering Lab | | | | | |
| 8 | SET/SH/BT/C207 | Chemistry Lab | - | - | 2 | 2 | 1 |
| | SET/SH/BT/C106 | Physics Lab | | | | | |
| 9 | SET/CS/BT/C208 | Computer Programming Lab | - | - | 2 | 2 | 1 |
| | SET/IT/BT/C108 | Information Technology Lab | | | | | |
| 10 | SET/ME/BT/S209 | **Engineering Workshop | - | - | 4 | 4 | 2 |
| **Total** | | | 17 | 5 | 10 | 32 | 22 |

* Ability Enhancement Compulsory course.

**Skill Enhancement Course.

## Semester III

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C301 | Mathematics III | 3 | 1 | - | 4 | 3 |
| 2 | SET/EC/BT/C302 | Electronic Devices and Circuits | 3 | 1 | - | 4 | 3 |
| 3 | SET/EC/BT/C303 | Digital Electronics | 3 | 1 | - | 4 | 3 |
| 4 | SET/EI/BT/C304 | Electrical Machines | 3 | 1 | - | 4 | 3 |
| 5 | SET/EI/BT/C305 | Signals and Systems | 3 | 1 | - | 4 | 3 |
| 6 | SET/EI/BT/C306 | Electrical Measurements and Instrumentation | 3 | 1 | - | 4 | 3 |
| 7 | SET/EC/BT/C307 | Digital Electronics Lab | - | - | 2 | 2 | 1 |
| 8 | SET/EI/BT/C308 | Signals and Networks Lab | - | - | 2 | 2 | 1 |
| 9 | SET/EI/BT/C309 | Electrical Measurements and Instrumentation Lab | - | - | 2 | 2 | 1 |
| 10 | SET/EI/BT/C310 | Electrical Machines Lab | - | - | 2 | 2 | 1 |
| 11 | SET/MC/BT/M311 | Indian Constitution (*MC) | - | - | - | Self study | Qualifying |
| **Total** | | | 18 | 6 | 8 | 32 | 22 |

*Mandatory Course.

## Semester IV

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C401 | Sensors and Transducers | 3 | 1 | - | 4 | 3 |
| 2 | SET/EC/BT/C402 | Analog Integrated Circuits | 3 | 1 | - | 4 | 3 |
| 3 | SET/EI/BT/C403 | Microprocessors and Microcontrollers | 3 | 1 | - | 4 | 3 |
| 4 | SET/EI/BT/C404 | Analytical Instruments | 3 | 1 | - | 4 | 3 |
| 5 | SET/EC/BT/C405 | Electromagnetic Field Theory | 3 | 1 | - | 4 | 3 |
| 6 | SET/EI/BT/C406 | Circuit Theory | 3 | 1 | - | 4 | 3 |
| 7 | SET/EC/BT/C407 | Analog Integrated Circuits Lab | - | - | 2 | 2 | 1 |
| 8 | SET/EI/BT/C408 | Microprocessors and Microcontrollers Lab | - | - | 2 | 2 | 1 |
| 9 | SET/EI/BT/C409 | Sensors and Transducers Lab | - | - | 2 | 2 | 1 |
| 10 | SET/EI/BT/C410 | Analytical Instruments Lab | - | - | 2 | 2 | 1 |
| 11 | SET/MC/BT/M411 | Essence of Indian Traditional Knowledge (*MC) | - | - | - | Self study | Qualifying |
| **Total** | | | 18 | 6 | 8 | 32 | 22 |

* Mandatory Course.

## Semester V

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C501 | Power Systems | 3 | 1 | - | 4 | 3 |
| 2 | SET/EI/BT/C502 | Control Systems | 3 | 1 | - | 4 | 3 |
| 3 | SET/EI/BT/C503 | Industrial Instrumentation | 3 | 1 | - | 4 | 3 |
| 4 | SET/EI/BT/C504 | Power Electronics | 3 | 1 | - | 4 | 3 |
| 5 | | PE-01 | 3 | 1 | - | 4 | 3 |
| 6 | SET/EI/BT/C506 | Power Systems Lab | - | - | 2 | 2 | 1 |
| 7 | SET/EI/BT/C507 | Control Systems Lab | - | - | 2 | 2 | 1 |
| 8 | SET/EI/BT/C508 | Industrial Instrumentation Lab | - | - | 2 | 2 | 1 |
| 9 | SET/EI/BT/C509 | Power Electronics Lab | - | - | 2 | 2 | 1 |
| 10 | SET/HS/BT/H510 | Foundations of Yoga (*HSMC) | 3 | 1 | - | 4 | 3 |
| **Total** | | | 18 | 7 | 8 | 32 | 22 |

* Humanities and Social Sciences including Management courses.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 01 (PE-01)** | 1 | SET/EI/BT/E505 (i) | Electrical Drives |
| | 2 | SET/EI/BT/E505 (ii) | Line Commutated and Active PWM Rectifiers |
| | 3 | SET/EI/BT/E505 (iii) | Electrical Machine Design |

## Semester VI

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/EC/BT/C601 | Digital Signal Processing | 3 | 1 | - | 4 | 3 |
| 2 | SET/EI/BT/C602 | PLC and Automation | 3 | 1 | - | 4 | 3 |
| 3 | SET/EI/BT/C603 | Process Control | 3 | 1 | - | 4 | 3 |
| 4 | | PE-02 | 3 | 1 | - | 4 | 3 |
| 5 | | OE-01 | 3 | 1 | - | 4 | 3 |
| 6 | SET/EI/BT/C606 | PLC and Automation Lab | - | - | 2 | 2 | 1 |
| 7 | SET/EI/BT/C607 | Process Control Lab | - | - | 2 | 2 | 1 |
| 8 | SET/EI/BT/C608 | Seminar | - | - | - | 4 | 1 |
| 9 | SET/SH/BT/A609 | Biology * | 3 | 1 | - | 4 | 3 |
| **Total** | | | 18 | 6 | 4 | 32 | 21 |

* Applied Science and Humanities.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 02 (PE-02)** | 1 | SET/EI/BT/E604 (i) | HVDC Transmission Systems |
| | 2 | SET/EI/BT/E604 (ii) | Industrial Electrical Systems |
| | 3 | SET/EI/BT/E604 (iii) | Industrial Drives and Controls |
| | 4 | SET/EI/BT/E604 (iv) | Electrical distribution System |

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Open Elective 01 (OE-01)** | 1 | SET/EI/BT/E605 (i) | Power Plant Engineering |
| | 2 | SET/EI/BT/E605 (ii) | Optical Instrumentation |
| | 3 | SET/EI/BT/E605 (iii) | Analog and Digital communication |

## Semester VII

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C701 | Biomedical Instrumentation | 3 | 1 | - | 4 | 3 |
| 2 | SET/EI/BT/C702 | Vacuum Instrumentation and Thin Film Deposition Techniques | 3 | 1 | - | 4 | 3 |
| 3 | | PE-03 | 3 | 1 | - | 4 | 3 |
| 4 | | OE-02 | 3 | 1 | - | 4 | 3 |
| 5 | | OE-03 | 3 | 1 | - | 4 | 3 |
| 6 | SET/EI/BT/C706 | Biomedical Instrumentation Lab | - | - | 2 | 2 | 1 |
| 7 | SET/EI/BT/C707 | Vacuum Instrumentation and Thin Film Deposition Techniques Lab | - | - | 2 | 2 | 1 |
| 8 | SET/EI/BT/C708 | Project Preparation | - | - | 2 | 2 | 1 |
| 9 | SET/EI/BT/C709 | Industrial Training Seminar | - | - | - | - | 1 |
| 10 | SET/HS/BT/H710 | Principles of Management (*HSMC) | 3 | 1 | - | 4 | 3 |
| **Total** | | | 18 | 6 | 6 | 30 | 22 |

* Humanities and Social Sciences including Management courses.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 03 (PE-03)** | 1 | SET/EI/BT/E703 (i) | Electrical Energy Conservation & Auditing |
| | 2 | SET/EI/BT/E703 (ii) | Power Quality and FACTS |
| | 3 | SET/EI/BT/E703 (iii) | Control Systems II |

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Open Elective 02 and 03 (OE-02, OE-03)** | 1 | SET/EI/BT/E704 (i) | Embedded Systems |
| | | SET/EI/BT/E705 (i) | |
| | 2 | SET/EI/BT/E704 (ii) | Fuzzy Logic & Neural Network |
| | | SET/EI/BT/E705 (ii) | |
| | 3 | SET/EI/BT/E704 (iii) | Introduction to Robotics |
| | | SET/EI/BT/E705 (iii) | |
| | 4 | SET/EI/BT/E704 (iv) | Computer Architecture |
| | | SET/EI/BT/E705 (iv) | |

**Semester VIII**

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | | PE-04 | 3 | 1 | - | 4 | 3 |
| 2 | | OE-04 | 3 | 1 | - | 4 | 3 |
| 3 | | OE-05 | 3 | 1 | - | 4 | 3 |
| 4 | SET/EI/BT/C804 | Major Project | - | - | 16 | 16 | 8 |
| **Total** | | | 9 | 3 | 16 | 28 | 17 |

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 04 (PE-04)** | 1 | SET/EI/BT/E801 (i) | Renewable Energy Engineering |
| | 2 | SET/EI/BT/E801 (ii) | Electrical Distribution System |
| | 3 | SET/EI/BT/E801 (iii) | Control Systems Design |
| | 4 | SET/EI/BT/E801 (iv) | Switchgear and Protection |

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Open Elective 04 and 05 (OE-04, OE-05)** | 1 | SET/EI/BT/E802 (i) | Data Communication and Networking |
| | | SET/EI/BT/E803 (i) | |
| | 2 | SET/EI/BT/E802 (ii) | Virtual Instrumentation |
| | | SET/EI/BT/E803 (ii) | |
| | 3 | SET/EI/BT/E802 (iii) | Smart Grid Technology |
| | | SET/EI/BT/E803 (iii) | |
| | 4 | SET/EI/BT/E802 (iv) | Mobile Communication and Networks |
| | | SET/EI/BT/E803 (iv) | |

## Note

(1) Topic for the Seminar in $6^{th}$ semesters shall be chosen by students in consultation with faculty. Topic shall not be mentioned in the syllabus anywhere, however, it should be related to Electrical and Instrumentation Engineering.

(2) Students shall choose 2 professional & 2 open elective subjects in $7^{th}$ Semester and 1 professional & 2 open elective subjects in $8^{th}$ semester, each from the given Table. An elective subject shall be offered only when at least 30% of the intake opt for that subject.

(3) Major Project work shall be carried out during the $7^{th}$ and $8^{th}$ semester. Students can undertake Major Project individually or in group of not more than Four students, under the guidance of a faculty or a group of faculty. Students have to present Synopsis of Major Project during the $7^{th}$ semester. Feasibility of the Project shall be assessed by the project evaluation committee of the department before the end of $7^{th}$ semester. However, Major Project would be evaluated in the end of $8^{th}$ semester.

**Detailed Syllabi**

**SEMESTER I**

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C101 | Mathematics I | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/SH/BT/C102 | Physics | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/SH/BT/C203 | Chemistry | | | | | | | | | |
| 3 | SET/EE/BT/C103 | Basic Electrical Engineering | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/ME/BT/C202 | Basic Mechanical Engineering | | | | | | | | | |
| 4 | SET/EC/BT/C104 | Basic Electronics | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/ME/BT/C204 | Engineering Mechanics | | | | | | | | | |
| 5 | SET/IT/BT/C105 | Fundamentals of Information Technology | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/CS/BT/C205 | Computer Programming | | | | | | | | | |
| 6 | AECC106 | *Environmental Science | 2 | - | - | 10 | 20 | 30 | 70 | 100 | 2 |
| 7 | SET/SH/BT/C106 | Physics Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/SH/BT/C207 | Chemistry Lab | | | | | | | | | |
| 8 | SET/EE/BT/C107 | Basic Electrical Engineering Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/ME/BT/C206 | Basic Mechanical Engineering Lab | | | | | | | | | |
| 9 | SET/IT/BT/C108 | Information Technology Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/CS/BT/C208 | Computer Programming Lab | | | | | | | | | |
| 10 | SET/ME/BT/S109 | **Engineering Graphics | | | 4 | 30 | - | 30 | 70 | 100 | 2 |
| | | | | | | | | | | **Total** | 22 |

* Ability Enhancement Compulsory course.
**Skill Enhancement Course.

L - Lecture hours, T - Tutorial hours, P - Practical hours, T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

**Induction program** for students to be offered right at the start of the first year. For **Induction Program** please refer **Appendix-I** for guidelines.

| SET/SH/BT/C101. MATHEMATICS I | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Vector Calculus** | Interpretation of Vectors & Scalars, Gradient, Divergence and Curl of a Vector and Their Physical Interpretation, Gauss Divergence Theorem and Stoke's Theorem. | 9 |
| **Matrices** | Elementary Row and Column Transformation, Linear Dependence, Rank of Matrix, Consistency of System of Linear Equation and Solution of Linear System of Equations. Characteristic Equation, Cayley-Hamilton Theorem, Eigen Values and Eigen Vectors, Diagonalization, Complex Matrices. | 13 |
| **Differential Calculus** | Libnitz theorem, Partial Differentiation, Euler's Theorem, Asymptotes, Curve Tracing, Envelops and Evolutes. Change of Variables, Jacobians, Expansion of Functions of One and Several Variables. Cylindrical and Spherical Coordinate System. Approximation of Errors. Extrema of Function of Several Variables, Langrange's Method. | 13 |
| **Probability and Statistics** | Binomial Distribution, Normal Distribution and Poisson's Distribution. Correlation and Regression. | 9 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers.<br>2. H K Das, "Advanced Engineering Mathematics", S Chand.<br>3. Erwin Kreyszig, "Advanced Engineering Mathematics". | |
| **References** | 1. Shanti Narayan, "A Text Book of Matrices", S. Chand .<br>2. Finney Thomas, "Calculus and Analytical Geometry", Narosa Publication House.<br>3. N. Piskunov, "Differential and Integral Calculus". | |

| SET/SH/BT/C102. PHYSICS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Optics** | Interference: Coherent Sources, Conditions of Interference, Fresnel's Biprism Experiment, Interference in Thin Films, Newton's Rings; Single and n-Slit Diffraction, Diffraction Grating, Raleigh's Criterion of Resolution, Resolving Power of Telescope, microscope; Phenomenon of Double Refraction, Ordinary and Extra-ordinary Rays, Nicol Prism, Circularly and Elliptically Polarized Light, Fresnel Theory, Optical Activity, Specific Rotation. | 13 |
| **Lasers and X-Rays** | Laser: Principle of Laser Action, Einstein's Coefficients, Construction and Working of He-Ne and CO2 laser; Diffraction of X-Rays, Bragg's Law, Practical Applications of X-Rays, Compton Effect. | 8 |
| **Basics Material Science** | Introduction to crystal structure of materials, Miller indices for crystallographic planes and directions. X-ray diffraction for determination of crystal structure. Defects in solids: point, line and planar defects and their effect on properties of materials. Band theory of solids, conductors, semi-conductors and insulators, metals. Fermi Level. Magnetism: dipole moments, paramagnetism, Curie's law, magnetization and hysterisis, Ferromagnetism and Anti-Ferromagnetism. Ferroelectricity and Piezoelectricity. Superconductivity in materials. | 14 |
| **Electromagnetism** | Ampere's Law and Displacement Current, Maxwell's Equations in Integral and Differential Forms, Electromagnetic Wave Propagation in Free Space and Conducting Media, Poynting Theorem. | 8 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. Gaur, Gupta, "Engineering Physics"<br>2. Callister W.D., "Materials Science and Engineering: An introduction", 6th Edition, John Wiley & Sons Inc., New York 2002 | |
| **References** | 1. J. R. Taylor, C.D. Zafiratos and M. A. Dubson, Modern Physics for Scientists and Engineers, , 2nd Ed.,Pearson (2007)<br>2. Arthur Beiser, Concepts of Modern Physics, 6th Ed., TMH, (2009)<br>3. A.K. Ghatak : Optics<br>4. Subramanyam, Brijlal : Optics<br>5. Wehr Richords & Adiav : Physics of Atoms<br>6. O.Svelto : Lasers<br>7. D.J. Griffith : Electrodynamics<br>8. Robert Eisberg and Robert Resnick, Quantum Physics of atoms, Molecules, Solids, Nuclei and Particle, 2nd Ed., John Wiley(2006)<br>9. Raghavan V. " Materials Science and Engineering – A first course" 5th Edition, Prentice Hall, New Delhi, 1998<br>10. Van Vlack, LH, " Elements of Materials Science and Engineering". 6th Edition, Addison – Wesley Singapore, 1989<br>11. B. G. Streetman, Solid state Devices, 5th Ed., Pearson (2006)<br>12. Dekker, "Electrical Engineering Materials", PHI | |

| SET/EE/BT/C103. BASIC ELECTRICAL ENGINEERING | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **DC Networks** | Concepts of linear, nonlinear, active, passive, unilateral and bilateral elements; Ideal and practical voltage & current sources – conversion from one from the other; Kirchhoff's laws – statements; Mesh Analysis; Nodal Analysis; Delta-Star & Star-Delta conversion; Superposition principle; Thevenin's theorem – statement, advantages in case of complex networks; explanation & illustration with examples; Norton's theorem, Maximum power transfer theorem, Reciprocity Theorem and its application. | 10 |
| **Single Phase AC Circuits** | Generation of single phase a.c. voltage and determination of average (mean) and RMS (effective) values of voltage and current with special reference to sinusoidal waveforms; Form factor and peak factor for various waves; Representation of sinusoidal time varying quantities as phasors; concepts of reactance, impedance and their representation in complex forms using j operator; Steady state analysis of series R-L-C circuit & its phasor diagram; Concept of power & power factor; Concept of admittance, susceptance in parallel circuits; Analysis of series parallel circuits & phasor diagrams; Resonance in series and parallel circuits. | 10 |
| **Filter Circuits** | Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter. | 4 |
| **Three Phase Circuits** | Generation of 3-phase balanced sinusoidal voltage; star & delta connections; line & phase quantities (current & voltage); Solution of 3-phase star/delta circuits with balanced supply voltage and balanced load; phasor diagram; 3-phase, 4-wire circuits; Measurement of three phase power by two wattmeter method; phasor diagram with balanced load and determination of load power factor from wattmeter readings. | 6 |
| **Transformers and Rotating Machines** | Transformers: Constructional features and principle of operation, concept of ideal transformer under no load & loaded conditions and its equivalent circuit; Practical transformer rating & its equivalent circuit; Autotransformer – principle of operation & relative advantages & disadvantages; Rotating Machine: construction features (stator, rotor & air gap), conditions for production of steady electromagnetic torque; Three phase Induction motor: constructional features and operation; DC Machines: construction features, EMF and Torque expression, Classification of D.C. motors and generators; Stepper motor. | 8 |
| **Measuring Instruments** | DC PMMC instruments – constructional feature and principle of operation; Moving iron meters – construction and principle of operation; Dynamometer type wattmeter; Induction type energy meter construction & principle of operation. | 6 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. I.J. Nagrath, "Basic Electrical Engineering," Tata Mc. Graw Hill. | |
| **References** | 1. A. E. Fitgerald, D.E., Higginbotham and A Grabel, "Basic Electrical Engineering", Mc Graw Hill.<br>2. Rizzoni, Principles and Applications of Electrical Engineering, TMH.<br>3. V. Del Toro. "Principles of electrical Engineering, "Prentice hall.<br>4. W.H. Hayt & J.E. Kemmerly," Engineering circuit Analysis, "Mc Graw Hill.<br>5. H. Cotton, "Advanced Electrical Technology" Wheeler Publishing. | |

| SET/EC/BT/C104. BASIC ELECTRONICS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Semiconductor Diodes** | Semiconductor materials- intrinsic and extrinsic types, Ideal Diode as switch, Terminal characteristics of PN diode - p-n junction under open circuit condition, p-n junction under forward bias and reverse bias conditions, p-n junction in breakdown region; Zener diode and applications e.g. voltage regulator; Rectifier Circuits, Clipping and Clamping circuits; LED, Photo Diode. | 10 |
| **Bipolar Junction Transistors** | Physical structure, physical operation and current-voltage characteristics of NPN transistor; Use of Voltage dependent Current source as an Voltage amplifier; Transistor as an amplifier: Characteristics of CE amplifier; Active region operation of transistor; D.C. analysis of Common Emitter Amplifier: load line analysis; Transistor as a switch: cut-off and saturation modes. | 10 |
| **Field Effect Transistor** | Enhancement-type MOSFET: structure and physical operation, current-voltage characteristics; MOSFET as a Switch, MOSFET as a Voltage dependent Current source and Amplifier. | 8 |
| **Operation Amplifier** | Ideal Op-amp; Properties of the ideal Operational Amplifier; op-amp application circuits (assuming ideal op amp): inverting amplifier, non -inverting amplifier, weighted summer, integrator, and differentiator. | 8 |
| **Digital Logic and Gates** | Binary, octal and hexadecimal number systems; Methods of base conversions; Binary, octal and hexadecimal arithmetic; Representation of signed numbers; Basic logic operations and logic gates; MOSFET Switch Implementation of Logic Gates e.g. Inverter, NAND, NOR. Basic postulates and fundamental theorems of Boolean algebra. | 8 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Agarwal, Anant; Lang, Jeffrey H, "Foundations of Analog and Digital Electronic Circuits", Elsevier Science & Technology Books. | |
| **References** | 1. V. Del Toro, Principles of Electrical Engineering, PHI.<br>2. Rizzoni, Principles and Applications of Electrical Engineering, TMH.<br>3. Malvino, Electronic Principles.<br>4. R.L.Boylestad & L.Nashelsky, Electronics Devices & Circuit Theory, PHI. | |

| SET/IT/BT/C105. FUNDAMENTALS OF INFORMATION TECHNOLOGY | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Definition of Electronic Computer, History, Generations, Characteristic and Application of Computers, Classification of Computers, Computer Hardware and Basic Computer Organization: CPU- ALU, CU; RAM/ROM, Various I/O devices, Peripherals, Storage Media. | 6 |
| **Computer Languages** | Binary, Hexadecimal Number System; Basic Binary Logic Operations; Binary Addition and Subtraction; Generation of Languages, Assembly Language, High level language; Translators, Interpreters, Compilers, Compilers; Flow Charts, Dataflow Diagram, Pseudo codes; Assemblers, Introduction to 4GLs. | 6 |
| **OS & Office** | Software- System and Application Software; Elementary Concepts in Operating System; Textual Vs GUI Interface, Introduction to DOS, MS Windows. | 6 |
| **Computer Networks** | Elements of Communication system; Brief Introduction to Computer Networks- Introduction of LAN and WAN. Network Topologies, Client-server Architecture. | 6 |
| **Internet** | Internet & World Wide Web, Hypertext Markup Language, DHTML, WWW, Gopher, FTP, Telnet, Web Browsers, Net Surfing, Search Engines, Email; Introduction to Web Development, Static and Dynamic Pages. | 6 |
| **IT Application and Multi media** | Basic Awareness of NICNET and ERNET; E Commerce, E governance; Brief Introduction to Different Formats of Image, Audio, Video. | 6 |
| **Information Concepts & Processing** | Definitions of Information , Need of information, quality of information, value of information, concept of information, Entropy category and Level of information in Business Organization, Data Concepts and Data Processing, Data Representation, Application of IT to E-commerce, Electronic Governance, Multimedia, Entertainment, Introduction to Information System. | 8 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Sinha, Sinha, “Computer Fundamentals”.<br>2. Yadav R. P., “Information Technology”. | |
| **References** | 1. D S Yadav, “Foundations of IT”, New Age, Delhi.<br>2. Rajaraman, “Introduction to Computers”, PHI.<br>3. Peter Nortans “Introduction to Computers”, TMH.<br>4. Patterson D.A. & Hennessy J.L., "Computer Organization and Design", Morgan Kaufmann Publishers. | |

| AECC106. ENVIRONMENTAL SCIENCE | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to Environmental Sciences** | Multidisciplinary nature of Environmental Sciences;<br>Scope and importance; Concept of sustainability and sustainable development. | 2 |
| **Ecosystems** | What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :<br>a. Forest ecosystem<br>b. Grassland ecosystem<br>c. Desert ecosystem<br>d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) | 6 |
| **Natural Resources: Renewable and Non-renewable Resources** | Land resources and land use change; Land degradation, soil erosion and desertification.<br>Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.<br>Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).<br>Energy resources: Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies. | 8 |
| **Biodiversity and Conservation** | Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots<br>India as a mega-biodiversity nation; Endangered and endemic species of India<br>Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.<br>Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. | 8 |
| **Environmental Pollution** | Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution<br>Nuclear hazards and human health risks<br>Solid waste management: Control measures of urban and industrial waste.<br>Pollution case studies. | 8 |
| **Environmental Policies & Practices** | Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture<br>Environment Laws: Environment Protection Act 1986; Air (Prevention & Control of Pollution) Act 1981; Water (Prevention and control of Pollution) Act 1974; Wildlife Protection Act 1972; Forest Conservation Act 1980. International agreements: Montreal protocol, Kyoto protocol and Convention on Biological Diversity (CBD).<br>Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context. | 7 |
| **Human Communities and the Environment** | Human population growth: Impacts on environment, human health and welfare.<br>Resettlement and rehabilitation of project affected persons; case studies.<br>Disaster management: floods, earthquake, cyclones and landslides.<br>Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.<br>Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.<br>Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). | 6 |
| **Field work** | Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.<br>Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.<br>Study of common plants, insects, birds and basic principles of identification.<br>Study of simple ecosystems-pond, river, lake, forest patch, grassland, Delhi Ridge, etc. | 5 |
| | **Total No. of Hours** | **50** |

Suggested Readings:


1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science,* 339: 36-37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp. 29-64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. *Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. *Tripathi 1992*.
14. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.
17. Thapar, V. 1998. *Land of the Tiger*: *A Natural History of the Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E. O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton.
20. World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University press

| SET/SH/BT/C106. PHYSICS LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. To determine the wavelength of monochromatic light by Newton's ring method.<br>2. To determine the wavelength of monochromatic light by Fresnel's biprism.<br>3. To determine the focal length of two lenses by nodal slide and locate the position of cardinal points.<br>4. To determine the wavelength of spectral lines using plane transmission grating. | 6x2 |
| 5. Measurement of Magnetic susceptibility- Quincke's Method / Gouy's balance.<br>6. Mapping of magnetic field. | 2x2 |
| 7. Measurement of e/m of electron – Thomson's experiment.<br>8. Determination of Planck's constant. | 2x2 |
| 9. To draw hysteresis curve of a given sample of ferromagnetic material and from this to determine magnetic susceptibility.<br>10. To study the Hall Effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material.<br>11. To determine the energy band gap of a given semiconductor material. | 4x2 |
| **Total No. of Hours** | **28** |

| SET/EE/BT/C107. BASIC ELECTRICAL ENGINEERING LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Study of analog voltmeter, ammeter, digital multimeter and CRO.<br>2. Verification of KCL and KVL.<br>3. Verification of Thevenin, Norton Network theorems.<br>4. Verification of Superposition Network theorem.<br>5. Verification of MPT Network theorem.<br>6. Verification of KCL and KVL.<br>7. Verification of Thevenin, Norton Network theorems.<br>8. Verification of Superposition Network theorem.<br>9. Verification of MPT Network theorem.<br>10. Measurement of efficiency of a single phase transformer by load test.<br>11. Determination of parameters and losses in single phase transformer by OC and SC test.<br>12. Measurement of power in a three phase circuit by two wattmeter method.<br>13. Verification of Single Phase Energy Meter constant.<br>14. Study of thee phase induction motor.<br>15. Verification of junction diode, zener diode characteristics.<br>16. Verification of Clipping and clamping circuits.<br>17. Verification of H.W. and F.W. rectifier circuit: with and without filter circuit and to determine the ripple factor.<br>18. Verification of CE characteristics of BJT. | 15x2 |
| **Total No. of Hours** | **30** |

| SET/IT/BT/C108. INFORMATION TECHNOLOGY LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Creation of a Word Document.<br>2. Creation of a Document in spreadsheet and using Formulae.<br>3. Use of Search Engine and World Wide Web.<br>4. Creation of email id and email.<br>5. Use of FTP service.<br>6. Creation of Static Web Pages using HTML.<br>7. Creation of Page Using Java Script.<br>(Besides these additional experiments can be included to give hands on experience to students. Students can be provided opportunity to work on any Information System to give them better understanding of Information System) | 14x2 |
| **Total No. of Hours** | **28** |

| SET/ME/BT/S109. ENGINEERING GRAPHICS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to Engineering Graphics** | Drawing instruments and their use – Different types of lines - Lettering & dimensioning – Familiarization with current Indian Standard Code of Practice for Engineering Drawing. Scales, Plain scales, Diagonal scales, Vernier scales. Introduction to orthographic projections- Horizontal, vertical and profile planes – First angle and third angle projections – Projection of points in different coordinates – Projections of lines inclined to one of the reference planes. | 12 |
| **Projections of lines and planes** | Projections of lines inclined to both the planes – True lengths of the lines and their angles of inclination with the reference planes – Traces of lines. Projection of plane lamina of geometric shapes inclined to one of the reference planes – inclined to both the planes, Traces of planes. Projections on auxiliary planes. | 12 |
| **Projections of polyhedral and solids** | Projections of polyhedral and solids of revolution, projection of solids with axis parallel to one of the planes and parallel or perpendicular to the other plane – Projections with the axis inclined to one of the planes. Projections of Solids with axis inclined to both the planes – Projections of spheres and combination of solids. | 12 |
| **Sections of solids** | Sections of solids by planes perpendicular to at least one of the reference planes – True shapes of sections. Developments, development of the lateral surface of regular solids like, prisms, pyramids, cylinders, cones and spheres, development of truncated solids Isometric projection – Isometric scale – Isometric views – Isometric projection of prisms, pyramids, cylinders, cones, spheres and solids made by combination of the above. | 12 |
| | **Total No. of Hours** | **48** |
| **Textbooks** | 1. Bhatt N. D, Elementary Engineering Drawing, Charotar Publishing House, Anand, 2002. | |
| **References** | 1. Narayana K L & Kannaiah P, Engineering Graphics, Tata McGraw Hill, New Delhi, 1992.<br>2. Luzadder W J, Fundamentals of Engineering Drawing, Prentice Hall of India, New Delhi, 2001.<br>3. Thomas E French & Charkes J V, Engineering Drawing & Graphing Technology, McGraw Hill Book Co, New York, 1993.<br>4. Venugopal K, Engineering Drawing & Graphics, New Age International Pvt. Ltd., New Delhi, 1994. | |

## SEMESTER II

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE. | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C201 | Mathematics II | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/ME/BT/C202 | Basic Mechanical Engineering | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EE/BT/C103 | Basic Electrical Engineering | | | | | | | | | |
| 3 | SET/SH/BT/C203 | Chemistry | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/SH/BT/C102 | Physics | | | | | | | | | |
| 4 | SET/ME/BT/C204 | Engineering Mechanics | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EC/BT/C104 | Basic Electronics | | | | | | | | | |
| 5 | SET/CS/BT/C205 | Computer Programming | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/IT/BT/C105 | Fundamentals of Information Technology | | | | | | | | | |
| 6 | AECC206 | *General English | 2 | - | - | 10 | 20 | 30 | 70 | 100 | 2 |
| 7 | SET/ME/BT/C206 | Basic Mechanical Engineering Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/EE/BT/C107 | Basic Electrical Engineering Lab | | | | | | | | | |
| 8 | SET/SH/BT/C207 | Chemistry Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/SH/BT/C106 | Physics Lab | | | | | | | | | |
| 9 | SET/CS/BT/C208 | Computer Programming Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/IT/BT/C108 | Information Technology Lab | | | | | | | | | |
| 10 | SET/ME/BT/S209 | **Engineering Workshop | - | - | 4 | 30 | - | 30 | 70 | 100 | 2 |
| | | | | | | | | | | **Total** | 22 |

* Humanities and Social Sciences including Management courses.

**Skill Enhancement Course.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| SET/SH/BT/C201. MATHEMATICS II | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Multiple Integral** | Double and triple integrals, change of order of integration. Change of variables, application to area, volume, centre of gravity, moment of inertia and product of inertia. Gamma and Beta functions, Drichlet's integral and its application. | 9 |
| **Fourier Series** | Periodic functions, Fourier series of functions with period 2n, change of interval, half range sine and cosine series. | 6 |
| **Integral Transform** | Laplace transforms, existence theorem, Laplace transform derivatives, inverse Laplace transform, application to solve linear differential equations, unit step function, Dirac delta function, Laplace transforms of periodic functions. Application of Laplace transforms. Definitions of Fourier and Z-transform and its simple applications. | 12 |
| **Ordinary Differential Equations** | Introduction to order, degree and arbitrary constants, linear differential equations of n" order with constant coefficient, complimentary functions and particular integrals. Homogeneous differential equations, simultaneous linear differential equations. Solutions of second order differential equations by changing dependent and independent variables. Method of variation of parameters, equations of the form y" = f(y), applications to engineering problems. | 12 |
| **Solutions of Equations and Curve Fitting** | Solutions of cubic and bi-quadric equations. Method of least square and curve fitting. | 6 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers.<br>2. H K Das, "Advanced Engineering Mathematics", S Chand.<br>3. Erwin Kreyszig, "Advanced Engineering Mathematics". | |
| **References** | 1. J. N. Kapoor, "A Text Book of Differential Equations". | |

| SET/ME/BT/C202. BASIC MECHANICAL ENGINEERING | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Laws of Thermodynamics** | Concept of temperature, equality of temperature, Zeroth law, principles of thermometry and temperature scale. First law of thermodynamics, concept of internal energy, application of first law to a closed system to various processes, flow processes and control volume, flow work, steady flow energy equation, mechanical work in steady flow process, throttling process, application of first law to open system. Essence of second law, thermal reservoir, heat engines and thermal efficiency. COP of heat pump and refrigerator, definition of available and unavailable energy. Statement of second law, Carnot cycle, Carnot's theorem, Clausius inequality, concept of entropy, entropy changes for ideal gases. | 8 |
| **Properties of Steam** | Generation of steam at constant pressure, various states of water, steam, properties of steam, use of property diagram, processes of vapour in closed and open system, determination of dryness fraction of steam by separating and throttling calorimeter, Rankine cycle. | 5 |
| **Thermodynamic Cycle** | Definitions of bore, stroke, clearance ratio, compression ratio, definition and calculation of mean effective pressure from the cyclic work (proof not required), indicated pressure, air standard cycle (Otto and diesel cycle), principle of working and description of two and four stroke S.I. and C.I. engine. | 8 |
| **Strength of Material-Simple Stresses and Strains** | Stress- tensile and compressive, strain, strain energy, stress-strain diagram, ductile and brittle material, elastic constants, impact loading, varying cross-section and load, temperature stresses, shear stress, complementary shear stress, shear strain. | 8 |
| **Compound Stresses and Strains** | State of stress at a point, oblique stress, simple tension, pure shear, general two dimensional stress system, principal planes, principal stresses and strains, Mohr's stress circle, Poisson's ratio, maximum shear stress. | 8 |
| **Bending Stress and Torsion** | Pure bending, moment of inertia, section modulus, bending stresses, combined bending and direct stress, beam of uniform strength, middle third and middle quarter rules for rectangular and circular sections, Circular shafts, torsional shear stress, strain energy in torsion, shafts under varying torque, compound shafts, combined bending and twisting. | 8 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. R S Khurmi, "Engineering Mechanics".<br>2. P K Nag "Engineering Thermodynamics". | |
| **References** | 1. Van Wylen G.J. & Sonnlog R.E.: Fundamentals of classical thermodynamics, John Wiley & Sons,Inc. NY.<br>2. Wark Wenneth : Thermodynamics (2nd edition), Mc Graw Hill book Co. NY.<br>3. Holman, J.P.: Thermodynamics, MC Graw Hill book Co. NY.<br>4. Yadav R.: Thermodynamics and Heat Engines, Vol I & II (Sl Edition) Central Publishing House Allahabad.<br>5. Yadav R.: Steam & Gas Turbines.<br>6. Kshitish Chandra Pal: Heat Power, Orient Longman Limited, 17, Chittranjan Avenue, Calcutta.<br>7. S. Rao, B.B. Parulekar, 'Energy Technology', Khanna Pub., New Delhi.<br>8. G. H. Ryder: "Strength of Materials".<br>9. F. L. Singer: "Strength of Materials".<br>10. Timoshenko: "Strength of Materials".<br>11. Beer, Johnson, Statics". | |

| SET/SH/BT/C203. CHEMISTRY | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Thermodynamics** | Terminology in Thermodynamics, Zeroth law of Thermodynamics, First law of Thermodynamics, Enthalpy, Reversible isothermal expansion of ideal gas, Adiabatic expansion of ideal gas, Joule-Thomson effect. | 4 |
| **Lubricants** | Theory, classification and mechanism of lubrication. | 4 |
| **Polymers** | Structures of the following polymers, viz, Natural and synthetic rubbers, Polyamide and Polyester fibres, polymethylmethacrylate, poly acrylonitrile and polystyrene. A brief account of conducting polymers (polypyrrole & polythiophene) & their applications. | 3 |
| **Complex Compounds** | Introduction, Valence bond and crystal field theory for bonding in complexes. | 4 |
| **Chemical Kinetics & Catalysis** | Order and molecularity of reactions, Catalysis- homogeneous and heterogeneous catalysis. Characteristics of catalytic reactions, catalytic promoters and poisons, auto catalysis and negative catalysis. Activation energy of catalysis, intermediate compound formation theory and adsorption theory. | 3 |
| **Atmospheric Chemistry& Air Pollution** | Environment and ecology, environmental segments, structure and composition of atmosphere, radiation balance of earth and Green House Effect, formation and depletion of Ozone layer, chemical and photochemical reactions of various species in atmosphere, air pollution- sources, reactions and sinks for pollutants, acid rains and smog formation. Pollution control methods. | 5 |
| **Corrosion** | Introduction, causes of corrosion, theories of corrosion- direct chemical attack, electrochemical theory of corrosion, factors influencing corrosion, passivity, types of corrosions, protection from corrosion (Cathodic and anodic protection) and protective metallic coatings (Galvanizing and tinning). | 5 |
| **Water and Waste Water Chemistry** | Introduction, Hardness of Water, Characteristics Imparted by Impurities, Determination of hardness by EDTA method, Treatment of Water by Zeolite, L-S Process, Boiler problems caused by use of hard Water, Reverse osmosis process for purification of water. Numerical based on hardness of water, zeolite process and Lime-soda process. | 6 |
| **Fuels & Combustion** | Classification of Fuels, Non-Conventional Energy, Biogas, and Solar Energy, Calorific value – Gross and Net, Characteristics of Good Fuel, Determination of Calorific Value by bomb calorimeter method (theory and numerical), Solid Fuels: Analysis of Coal (Proximate and ultimate analysis of coal theory and numerical), Liquid Fuels: mining and refining of petroleum, cracking (Thermal and catalytic), Knocking, octane and cetane number . | 5 |
| **Stereochemistry of Organic-Compounds** | Mechanism of Chemical Reaction, Beckman, Hoffman, Reimer Tiemann, Cunnizzaro, Diels- Alder and Skraup synthesis. | 4 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. Jain, Jain, "Engineering Chemistry".<br>2. Sharma, Kumar, "Engineering Chemistry". | |
| **References** | 1. R. T. Morrison and R N Boyd, "Organic Chemistry", 6th Edition, Prentice Hall, New Delhi.<br>2. J. D. Lee, "Concise Inorganic Chemistry", Chapman & Hall.<br>3. W. L. Jolly, "Modern Inorganic Chemistry", McGraw-Hill.<br>4. P.W. Atkins, "Physical Chemistry", 6th Edition, Oxford University Press.<br>5. Barrow, "Physical Chemistry".<br>6. Manahan, "Environmental Chemistry".<br>7. D. L. Pavia, GM. Lampman, GS. Kriz and J.R Vyvyan, I, "Spectroscopy", Cengage Learning India Pvt. Ltd, New Delhi, 2007.<br>8. R.M. Silverstein, F.X. Webster and D.J. Kiemle, "Spectrometric Identification of Organic Compounds", 7th edition, John-Wiley and Sons, New York, 2005.<br>9. William Kemp, "Organic Spectroscopy", 3rd edition, Palgrave, New York, 2005.<br>10. C.N. Banwell and E. M. McCash, "Fundamentals of Molecular Spectroscopy", McGraw- Hill, International, UK, 1995.<br>11. F. Carey, "Organic Chemistry", 5th Edition, McGraw Hill Publishers, Boston, 2003. | |

| SET/ME/BT/C204. ENGINEERING MECHANICS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Force System** | Introduction: Force system, dimensions and units in mechanics, laws of mechanics, vector algebra, addition and subtraction of forces, cross and dot products of vectors, moment of a force about a point and axis, couple and couple moment, transfer of a force to a parallel position, resultant of a force system using vector method, Problems involving vector application Equilibrium: Static and dynamic equilibrium, static in determinacy, general equations of equilibrium, Varingnon's theorem, Lami's theorem, equilibrium of bodies under a force system, Problems. | 10 |
| **Trusses And Frames** | Truss and Frames: Truss, classification of truss, assumptions in truss analysis, perfect truss, analysis of perfect plane truss using method of joints and method of sections, Problems. | 10 |
| **Centre Of Gravity And Moment Of Inertia** | Centroid, Centre of mass and Centre of gravity, Determination of centroid, centre of mass and centre of gravity by integration method of regular and composite figures and solid objects, Problems, Moment of Inertia: Area moment of inertia, mass moment of inertia, parallel axis and perpendicular axis theorems, radius of gyration, polar moment of inertia, product of inertia, principle axis, problem based on composite figures and solid objects. | 13 |
| **Kinematics And Dynamics** | Kinematics: Concept of rigid body, velocity and acceleration, relative velocity, translation and rotation of rigid bodies, equations of motion for translation and rotation, problems. Particle Dynamics: Energy methods and momentum methods, Newton's laws, work energy equation for a system of particles, linear and angular momentum equations, projectile motion, problem. | 12 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. R S Khurmi, "Engineering Mechanics".<br>2. P K Nag "Engineering Thermodynamics". | |
| **References** | 1. Van Wylen G.J. & Sonnlog R.E.: Fundamentals of classical thermodynamics, John Wiley & Sons,Inc. NY.<br>2. Wark Kenneth: Thermodynamics (2nd edition), Mc Graw Hill book Co. NY.<br>3. Holman, J.P.: Thermodynamics, MC Graw Hill book Co. NY.<br>4. Yadav R.: Thermodynamics and Heat Engines, Vol I & II (Sl Edition) Central Publishing House Allahabad.<br>5. Yadav R.: Steam & Gas Turbines.<br>6. Kshitish Chandra Pal: Heat Power, Orient Longman Limited, 17, Chittranjan Avenue, Calcutta.<br>7. S. Rao, B.B. Parulekar, 'Energy Technology', Khanna Pub., New Delhi.<br>8. G. H. Ryder: "Strength of Materials".<br>9. F. L. Singer: "Strength of Materials".<br>10. Timoshenko: "Strength of Materials".<br>11. Beer, Johnson, Statics. | |

| SET/CS/BT/C205. COMPUTER PROGRAMMING | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | C Character Set, Identifiers and Keywords, Data Types, Declarations, Expressions, Statements and Symbolic Constants. | 6 |
| **Operators and Expressions** | Arithmetic, Unary, Relational, Logical, and Assignment Operators, Conditional Operator, Library Functions. | 6 |
| **Control Statements** | While, Do-while, For Statements, Nested Loops, If-Else, Switch, Break, Continue and Go to Statements, Comma Operator. | 5 |
| **Functions** | Defining and Accessing Functions, Function Prototypes, Passing Arguments, Recursion, and Use of Library Functions. | 5 |
| **Program Structure** | Storage classes, Automatic, External, Static Variables. | 4 |
| **Arrays** | Defining and Processing, Passing to a Function, Multidimensional Arrays, Arrays and Strings. | 4 |
| **Pointers** | Declarations, Passing to a Function, Operations on Pointers, Pointers and Arrays, Dynamic Memory Allocation, Array of Pointers. | 6 |
| **Structures and Unions** | Basics of Structures, Structures and Functions, Arrays of Structures, Pointers to Structures, Self Referential Structures, type definitions, Unions. | 4 |
| **Data Files** | Open, Close, Create, Process, Unformatted data files. | 4 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. E. Balagurusamy, “Programming in ANSI C”. | |
| **References** | 1. Byron S. Gottfried, “Programming With C”.<br>2. Yashwant Kanitker, “LET US C”.<br>3. B. W. Kernighan and D. M. Ritchie, “The C Programming Language”.<br>4. B. W. Kernighan, “The Practice of Programming”, Addison-Wesley, 1999.<br>5. C. L. Tondo and S. E. Gimpel, “The C Answer Book”, (2/e), Prentice Hall, 1988. | |

| AECC206. GENERAL ENGLISH | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| Introduction: | Theory of Communication, Types and modes of Communication | 6 |
| Language of Communication | Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication | 6 |
| Speaking Skills | Monologue Dialogue Group Discussion Effective Communication/ Mis- Communication Interview Public Speech | 7 |
| Reading and Understanding | Reading and Understanding Close Reading Comprehension Summary Paraphrasing Analysis and Interpretation Translation(from Indian language to English and vice-versa) Literary/Knowledge Texts | 7 |
| Writing Skills | Documenting Report Writing Making notes Letter writing | 4 |
| | **Total No. of Hours** | **30** |
| Textbooks | 1. Fluency in English - Part II, Oxford University Press, 2006.<br>2. Business English, Pearson, 2008.<br>3. Language, Literature and Creativity, Orient Blackswan, 2013.<br>4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas | |

| SET/ME/BT/C206. BASIC MECHANICAL ENGINEERING LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Study of boiler models – Babcock Wilcox, Lancashire and Locomotive.<br>2. Study of Steam Engine and Steam Turbine models.<br>3. Study of 2-Stroke and 4-Stroke ICE models.<br>4. Study of vapour compression Refrigeration unit tutor.<br>5. Study of window type air conditioner.<br>6. To conduct the tensile test on a UTM and determine ultimate tensile strength, percentage elongation for a steel specimen.<br>7. To conduct the compression test and determine the ultimate compressive strength for a specimen.<br>8. To conduct impact test (Izod/Charpy) on the impact testing machine and find the impact strength.To determine the hardness of the given specimen using Brinell/Rockwell/Vicker testing machine. | 15x2 |
| **Total No. of Hours** | **30** |

| SET/SH/BT/C207. CHEMISTRY LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. To determine Saponification value of given oil sample.<br>2. To determine the ferrous content in the supplied sample of iron ore by titrimetric analysis against standard $K_2Cr_2O_7$ solution using $K_3Fe(CN)_6$ as external indicator.<br>3. To determine the chloride content in supplied water sample using Mohr's method.<br>4. To determine acid value of given oil sample.<br>5. To determine the total hardness of water sample by EDTA titration.<br>6. To find chemical oxygen demand of a waste water sample using Potassium Dichromate.<br>7. Estimation of iron in plain carbon steel by redox titration.<br>8. Estimation of copper in brass by titration method.<br>9. Estimation of Zinc in brass by titration method.<br>10. Analysis of a coal sample by proximate analysis method. | 15x2 |
| **Total No. of Hours** | **30** |

| SET/CS/BT/C208. COMPUTER PROGRAMMING LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| This lab shall have minimum 25 programs in C. There shall be minimum two programs per module as taught in theory. Programming shall follow logic/algorithm and flowchart wherever applicable. Exercises shall also enhance analytical and debugging abilities. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/ME/BT/S209. ENGINEERING WORKSHOP | | |
|---|---|---|
| **Module** | **Content** | **No. of Hrs.** |
| **Module 1** | Mechanical Engineering covering, the following trades for experiments (with a minimum of two exercises under each trade) - Carpentry, Fitting, Tin-Smithy and Development of jobs carried out and soldering, Black Smithy, House Wiring, Foundry (Molding only), Plumbing. | 16X2 |
| **Module 2** | Power tools in Construction, Wood working, Electrical and Mechanical Engineering practices. | 8x2 |
| | **Total No. of Hours** | **48** |

**SEMESTER III**

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE. | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C301 | Mathematics III | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/EC/BT/C302 | Electronic Devices and Circuits | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 3 | SET/EC/BT/C303 | Digital Electronics | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 4 | SET/EI/BT/C304 | Electrical Machines | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 5 | SET/EI/BT/C305 | Signals and Systems | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 6 | SET/EI/BT/C306 | Electrical Measurements and Instrumentation | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 7 | SET/EC/BT/C307 | Digital Electronics Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 8 | SET/EI/BT/C308 | Signals and Networks Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 9 | SET/EI/BT/C309 | Electrical Measurements and Instrumentation Lab | - | - | 1 | 30 | - | 30 | 70 | 100 | 1 |
| 10 | SET/EI/BT/C310 | Electrical Machines Lab | - | - | 1 | 30 | - | 30 | 70 | 100 | 1 |
| 11 | SET/MC/BT/M311 | Indian Constitution (*MC) | - | - | - | - | - | - | - | 100 | - |
| | | | | | | | | | | **Total** | 22 |

*Mandatory Course.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| SET/SH/BT/C301. MATHEMATICS III | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Ordinary Differential Equations** | ODE of 2nd order with constant coefficients both homogeneous and non-homogeneous types with applications to electrical and mechanical systems. Difference equations and their solutions by Z transform. Series solutions of ODE of 2nd orders with variable coefficients with special emphasis to the differential equations of Legendre, Bessel and Chebyser. Legendre's polynomials, Chabyshev polynomials and Bessel's functions and their properties. | 14 |
| **Integral Transforms** | Fourier transform and integral Hankel transforms and Hilbert transforms and their properties, some simple applications. | 7 |
| **Partial Differential Equations** | Linear PDE with constant coefficients of 2nd order and their classifications. PDE of parabolic, elliptic and hyperbolic type with illustrative examples. Separation of variables method for solving PDE, such as two dimensional heat equations, wave equations and Laplace equations. | 10 |
| **Functions of a Complex Variable** | Analytic functions, Cauchy Riemann equations, harmonic functions line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula derivatives of analytic function, Liouvilles theorem, fundamental theorem of algebraic representation of a function by power series, Taylor's & Laurant series, poles & singularity of zeros. Residue theorem, conformal mapping, linear fractional transformation, special linear tranctional transformations. | 14 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers.<br>2. H K Das, "Advanced Engineering Mathematics", S Chand.<br>3. Erwin Kreyszig, "Advanced Engineering Mathematics". wiley publications. | |
| **References** | 1. Paopoulis, "Signal Analysis", TMH. | |

| SET/EC/BT/C302. ELECTRONIC DEVICES AND CIRCUITS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Natural signals, need of amplification and linearity, concept of gain, decibel, bandwidth, power dissipation; Concept of biasing and small signal; dc and ac analysis, concept of small signal model, concept of input impedance, output impedance and their estimation; Circuit models for different amplifier types: voltage, current, transconductance, trans-resistance; Introduction to octagon of tradeoffs in analog circuits; | 4 |
| **Diodes and application** | Qualitative analysis of PN Junction diode in different bias conditions: no bias, forward, reverse, breakdown ; Current Voltage characteristic; Exponential Model, Piece wise linear model, constant voltage drop model, ideal diode model, Diode-large signal and small signal operation; Diode Circuits; Introduction and applications of Special Diodes: Zener Diode, Schottkey Diode, Photo Diode; Varactor Diode, Tunnel Diode, Light Emitting Diode; | 5 |
| **BJT Amplifiers** | BJT operation and characteristics: active mode, saturation mode; BJT Models: large signal model, transconductance, small signal model, hybrid $-\pi$ model, Ebres –Mall model; early effect; Amplifier: input impedance, output impedance, gain; Operating point analysis and design: simple biasing, resistive divider biasing, biasing with emitter degeneration, self bias, and design procedures; Analysis and Design of different topologies: CE, CE with emitter degeneration, CB, CC (Emitter follower); Multi-stage amplifier; Bipolar Cascode Amplifier, Bipolar current mirror; Bipolar differential amplifier; | 10 |
| **MOSFET Amplifiers** | MOSFET operation and characteristics: MOSFET as variable resistor, channel pinch off, derivation of I-V characteristics, triode and saturation region, transconductance; MOS device models: large signal model, small signal model, channel length modulation; comparison of Bipolar transistor and MOSFET; MOS Amplifier topologies and their comparison; DC and AC analysis of CS, CS with current source load, CS with diode connected load, CS with degeneration, CG, CD (source follower), and CMOS Cascode amplifier, MOS current mirror; MOS differential amplifier. | 10 |
| **Frequency Response** | Poles and zeroes in circuits, Bode plot, miller's theorem, high frequency models for BJT and MOSFET; transit or cut-off frequency of device; frequency response of CE and CS amplifier and calculation of their poles, zeroes; bandwidth, effect of frequency on I/O impedances. | 5 |
| **Feedback** | Negative feedback: gain desensitization, bandwidth extension, modification of I/O impedances, linearity improvement; types of amplifiers: voltage, trans-impedance, trans-conductance, and current amplifiers; Sense and return techniques; polarity of feedback; feedback topologies: voltage-voltage feedback, voltage-current feedback, current-voltage feedback, current-current feedback; Stability in feedback systems: problem of instability, stability condition, Nyquist stability criterion, phase margin, frequency compensation; Barkhousen condition for Oscillations, Sinusoidal oscillators. | 6 |
| **Power Amplifiers** | Distortion and efficiency; emitter follower as power amplifier; push-pull stage, high fidelity design using feedback; heat dissipation, thermal runaway; efficiency of emitter follower and push-pull stage; power amplifier classes; Tuned Amplifiers: basics, inductor losses, transformer coupled amplifiers, amplifier with multiple tuned circuits, cascode and CC-CB cascade, tuning, class C tuned amplifier. | 5 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. Sedra, Smith, "Microelectronic Circuits", Oxford University Press.<br>2. Behzad Razavi, "Fundamental of Microelectronic Circuits", Wiley. | |
| **References** | 1. Millman, Halkias, "Electronic Devices and Circuits".<br>2. B. G. Streetman, "Solid state Devices", Pearson.<br>3. David A. Bell, "Electronic Devices and Circuits".<br>4. R.L.Boylestad, L.Nashelsky, "Electronics Devices & Circuit Theory" PHI. | |

| SET/EC/BT/C303. DIGITAL ELECTRONICS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Positional number system; Binary, octal and hexadecimal number systems; Methods of base conversions; Binary, octal and hexadecimal arithmetic; Representation of signed numbers; Fixed and floating point numbers. Definition and specification of combination logic; Truth table; Basic logic operation and logic gates; Binary coded decimal codes; Gray codes. | 6 |
| **Boolean Algebra and Switching Functions** | Basic postulates and fundamental theorems of Boolean algebra; Standard representation of logic functions - SOP and POS forms; Simplification of switching functions - K-map. | 4 |
| **Logic Families** | Diode, BJT and MOSFET as a switch. Introduction to different logic families; Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product; circuit description and operation; RTL; DTL,HTL,TTL and sub families , Brief idea of ECL, CMOS BI-CMOS. | 10 |
| **Combinational Logic** | Arithmetic modules: adders, subtractors and ALU; Design examples. Decoders, encoders, multiplexers and de-multiplexers; Parity circuits and comparators. | 6 |
| **Sequential Logic** | Basic sequential circuits- latches and flip-flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop and their inter-conversions; Timing hazards and races; Meta-stability; Analysis of state machines using D flip-flops and JK flip-flops; Definition of state machines, synchronous sequential logic, shift register, counters-ripple and mod counters. | 12 |
| **Semiconductor Memories** | RAM, ROM, Content Addressable Memory, Charge Coupled Device Memory. PLAs, PALs and their applications; Sequential PLDs and their applications. | 6 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Morris Mano, “Digital Design”. Prentice Hall. | |
| **References** | 1. Taub, Schilieng, “Digital Integrated Electronics”. McGraw-Hill Publication.<br>2. Anad Kumar, “Digital principles and application”. Prentice Hall.<br>3. John F Wakerly, “Digital Design: Principles and Practices”, Prentice Hall.<br>4. Thomas L. Floyd, “Digital Fundamentals”, Pearson/ Prentice Hall.<br>5. Ronald J. Tocci, “Digital Systems: Principles and Applications”, Pearson/ Prentice Hall.<br>6. Charles Roth, “Fundamentals of Logic Design”, Jaico Publishing House. | |

| SET/EI/BT/C304. ELECTRICAL MACHINES | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **DC Machines** | Constructing feature and principal of operation of shunt, series and compound generators and motors including emf equation and armature reaction. Performance characteristics of generators and motors, starting, speed control and breaking of motors. Two quadrant and four quadrant operation of motors, choice of dc motors for different applications, losses and efficiency. | 14 |
| **Transformers** | Basics of transformers, Equivalent circuit of transformers, Transformer and its phasor diagram with load, without load and Three phase transformers, Auto transformers, Instrument transformers. | 8 |
| **Induction motors** | Starters for cage and wound rotor type induction motors, speed control and breaking, torque slip characteristics, single phase induction motors and methods of starting, principle and operation of three phase induction motor , Different methods of speed control. | 10 |
| **Synchronous Machines** | Construction, emf, effect of pitch and distribution, armature reaction and determination of regulation of synchronous generators, principle of motor operation, effect of excitation on line current (V-curves).method of synchronization, typical applications of ac motors in industries. | 12 |
| | **Total No. of Hours** | **44** |
| **References** | 1. Nagrath &Kothari, Electrical Machines, Tata McGraw Hill.<br>2. P. S. Bimbhra, Electrical Machine, Khanna Publications, Delhi.<br>3. B. L. Theraja, Electrical Techonology Vol-II. Tata McGraw Hill.<br>4. Cotton H., Advance Electrical Techonology, Wheeler & Co. | |

| SET/EI/BT/C305. SIGNALS AND SYSTEMS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to signals** | Classification of signals, basic continuous- time and discrete- time signals, step and impulse functions, transformation of independent variable. Sampling, Quantization, Encoding; Sampling theorem. | 8 |
| **Introduction to systems** | Properties of systems, classification of systems, mathematical model for systems, normal form of system equations, initial conditions; Impulse response of a physical system, Introduction to convolution, Convolution integral, numerical convolution. , auto correlation function, properties of auto correlation function, cross correlation functions, properties of cross correlation functions. | 8 |
| **Fourier Analysis** | Representation of signals in terms of elementary signals, condition for orthogonality, representation of signals by elementary sinusoids, Fourier series representation, power spectrum, Fourier Transform, system function, energy spectrum, Calculation of simple transforms, Discrete Fourier Transform (DFT), properties of Discrete Fourier Transform. | 12 |
| **Laplace Transform** | Convergence of laplace transform, Properties of laplace transform, inversion of laplace transform, solution of differential equation, bilateral laplace transform. | 8 |
| **Z-transform** | Z-transform, convergence of Z-transform, properties of Z-transform, inversion of Z-transform, evaluation of system frequency response, applications of Z-transform. | 8 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Simon Haykin, "Signals & Systems", John Wiley publications.<br>2. Oppenheim, Wilskey, "Signals and Systems", PHI publications. | |
| **References** | 1. B.P.Lathi, "Linear systems and signals", OUP publications.<br>2. Paopoulis, "Signal Analysis", TMH publications. | |

| SET/EI/BT/C306. ELECTRICAL MEASUREMENTS AND INSTRUMENTATION | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Electrical Instruments** | D'Arsonval Galvanometer. Working principle and operation of PMMC, MI, electrodynamometer and rectifier type instruments. Wattmeters - introduction, electrodynamics type wattmeter, theory, shape of scale, errors. Potentiometers - DC potentiometer - introduction, basic potentiometer circuit, laboratory type, multi-range, precision type, Vernier type, volt ratio box, applications. AC potentiometer - introduction, types, applications. Instrument transformers - introduction, use, ratios, burdens. Current transformers - relationships, errors. Potential transformer - introduction, relationships, errors. | 16 |
| **Measurements** | Measurement of voltage, current, power, power factor and energy. Measurement of resistance - measurement of low (Kelvin double bridge method), medium (ammeter-voltmeter, substitution, Wheatstone bridge & Ohmmeter method) and high resistance (guard circuit, direct deflection, loss of charge and Megohm bridge method) and earth resistance measurement. | 16 |
| **AC bridges** | Sources and detectors, general equation for bridge balance, general form of AC bridge. Self inductance bridges - Maxwell's inductance, Maxwell's inductance-capacitance, Hay's, Anderson and Owen's bridge. Capacitance bridges - Desauty and Schering bridges. Mutual inductance bridges – Heaviside and Campbell bridges. Frequency bridge – Wien's bridge. Sources of errors in bridge circuits. | 13 |
| | **Total No. of Hours** | **45** |
| **References** | 1. A K Sawhney, "Electrical and Electronic Measurements and Instrumentation"<br>2. E. W. Golding & F. E. Widdis, "Electrical Measurements and Measuring Instruments" | |

| SET/EC/BT/C307. DIGITAL ELECTRONICS LAB | | |
|---|---|---|
| **Content** | | **No. of Hrs.** |
| 1. Combinational Logic design using basic gates (Code Converters, Comparators).<br>2. Combinational Logic design using decoders and MUXs.<br>3. Arithmetic circuits - Half and full adders and subtractions.<br>4. Arithmetic circuits – design using adder ICs, BCD adder.<br>5. Flip flop circuit (RS latch, JK & master slave) using basic gates.<br>6. Asynchronous Counters.<br>7. Synchronous counters, Johnson & Ring counters.<br>8. Sequential Circuit designs (sequence detector circuit).<br>9. Transfer Characteristics, Measurement of Sinking and Sourcing currents etc. of TTL gates. | | 10x2 |
| **ModelSim Simulations** | Writing and simulating programs for adder, decoder, multiplexer, de-multiplexer, up/down counter, universal shift register, Sequence Detector etc. | 4x2 |
| | **Total No. of Hours** | **28** |

| SET/EI/BT/C308. SIGNALS AND NETWORKS LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Programming using MATLAB. | 10x2 |
| 2. Verification of principle of superposition with dc and ac sources.<br>3. Verification of Thevenin, Norton and Maximum power transfer theorems in ac circuits.<br>4. Verification of Tellegin's theorem for two networks of the same topology.<br>5. Determination of transient response of current in RL and RC circuits with step voltage input.<br>6. Determination of frequency response of current in RLC circuit with sinusoidal ac input. | 4x2 |
| **Total No. of Hours** | **28** |

| SET/EI/BT/C309. ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Study of electrical instruments: MI, PMMC, Dynamometer, wattmeter. Energy meter, potentiometer and instrument transformer.<br>2. Calibration of instruments: AC voltmeter and ammeter.<br>3. Wheatstone bridge and Kelvin's Bridge for Measurement of Resistance.<br>4. Schering Bridge for Capacitance Measurement and Anderson Bridge for Inductance Measurement.<br>5. Calibration of Single-phase Energy meter and Wattmeter.<br>6. Testing of Current Transformer. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/EI/BT/C310. ELECTRICAL MACHINES LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Open circuit characteristic of DC Shunt Generator.<br>2. Load test on DC Shunt Generator.<br>3. Speed control of DC Shunt Motor.<br>4. Brake test on DC Shunt Motor.<br>5. Load test on Single - phase Transformer.<br>6. Load test on three - phase Induction Motor.<br>7. Brake test on Single - phase Induction Motor.<br>8. Open Circuit test.<br>9. Short circuit test.<br>10. Speed control of three phase Induction motor. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/MC/BT/M311. INDIAN CONSTITUTION | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy | 6 |
| **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 | 6 |
| **State Government and its Administration** | Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and<br>Functions | 4 |
| **Local Administration** | District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected<br>Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy. | 8 |
| **Election Commission** | Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State<br>Election Commission: Role and Functioning, Institute and<br>Bodies for the welfare of SC/ST/OBC and women | 6 |
| | **Total** | **30** |

**SEMESTER IV**

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C401 | Sensors and Transducers | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/EC/BT/C402 | Analog Integrated Circuits | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 3 | SET/EI/BT/C403 | Microprocessors and Microcontrollers | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 4 | SET/EI/BT/C404 | Analytical Instruments | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 5 | SET/EC/BT/C405 | Electromagnetic Field Theory | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 6 | SET/EI/BT/C406 | Circuit Theory | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 7 | SET/EC/BT/C407 | Analog Integrated Circuits Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 8 | SET/EI/BT/C408 | Microprocessors and Microcontrollers Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 9 | SET/EI/BT/C409 | Sensors and Transducers Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 10 | SET/EI/BT/C410 | Analytical Instruments Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 11 | SET/MC/BT/M411 | Essence of Indian Traditional Knowledge (*MC) | - | - | - | - | - | - | - | 100 | - |
| | | | | | | | | | | **Total** | 22 |

*Mandatory Course.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| SET/EI/BT/C401. SENSORS AND TRANSDUCERS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Sensors and Transducers; Types of sensors and transducers; Characteristics of transducers, static calibrations, mathematical model of transducers, 0, 1st, 2nd order transducers, response to step, ramp and impulse inputs. | 6 |
| **Measurement & Error Analysis** | Units and standards, calibration techniques, classification of errors. Static and dynamic characteristics - accuracy, repeatability, hysteresis, resolution, reproducibility, precision etc. | 5 |
| **Displacement, Speed, Velocity and Acceleration Measurement** | Resistive transducers, Potentiometric, metal and semiconductor strain gauges, strain gauge applications; inductive transducers, Transformer type, LVDT, synchros, eddy current transducers, proximity detectors; capacitive transducers; Relative velocity, translational & rotational velocity measurement, revolution counters & timers, magnetic & photoelectric pulse counting, Tacho generators, stroboscopic methods. Basics of Gyroscope; Accelerometers – seismic, piezoelectric; Hall effect sensors, Magnetostrictive transducers. | 12 |
| **Force, Power, Torque, Shock & Vibration Measurement** | Force measurement, analytical balance, weighing systems and weighers, spring balance, load cell, pneumatic load cell, magneto-elastic load cell, piezoelectric load cell, elastic load cell. Torque measurement - mechanical, optical and electrical methods. Power measurement-dynamometers. Vibration measurement, vibrators shaper, piezo-electric and variable reluctance pick-ups. | 10 |
| **Signal Conditioning** | Instrumentation amplifier, lock-in amplifier, charge amplifier; Active and Passive Filters- 1st, 2nd order filters, LP, HP, notch, all pass filters, Butterworth, elliptic, Bessel and chebyshev filters. | 12 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. Murthy D. V. S, "Transducers and Instrumentation", Prentice Hall, New Delhi, 1995. | |
| **References** | 1. Renganathan, S., "Transducer Engineering", Allied Publishers, 2003.<br>2. Patranabis, "Sensors and Transducers", 2nd Edition, Prentice Hall India Pvt. Ltd., 2003.<br>3. C. S. Rangan, V. S. V. Mani & G. R. Sharma, "Instrumentation Devices and Systems". Mcgraw Hill Education.<br>4. A K Sawhney, "Electrical and Electronic Measurement and Instrumentation". Dhanpat Rai Publication.<br>5. John P. Bentley, "Principles of Measurement Systems", 3rd Edition, Pearson Education.<br>6. H. K. P. Neubert, "Instrument Transducers". Oxford University Press<br>7. E. O. Doebelin, "Measurement Systems Application and Design", McGraw Hill publications.<br>8. P. Horowitz & W. Hill, "The Art of Electronics", Cambridge Press publications. | |

| SET/EC/BT/C402. ANALOG INTEGRATED CIRCUITS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Operational Amplifiers, DC and AC characteristics; Applications of Op-amp: Precision rectifiers, Log and antilog amplifiers, four quadrant multipliers. Instrumentation amplifier, Sample and Hold Circuits. | 9 |
| **Active filters** | Introduction to filters. Butterworth, Chebyshev & Bessel filter; LC ladder filter – prototype & synthesis; Frequency transformation of low pass filter. Impedance converters; Gm-C filters, Active-RC Filters; Switched capacitor filter. | 8 |
| **Multivibrators and Pulse shaping circuits** | Multivibrators using op amps; 555 timer; Triggering circuits for bistable and monostable multivibrators; Programmable timer; Pulse shaping circuits. | 6 |
| **PLL** | Analog multiplexer, PLL and its applications, Frequency synthesizers, Coherent synthesizers using PLL, Direct digital synthesis, Phase noise in oscillators. | 6 |
| **Power supply Regulators** | Voltage regulators, Regulators using op amps, IC regulators, Protection circuits, Foldback current limiting, current boosting of IC regulators, switching regulators. | 6 |
| **DACs and ADCs** | D/A Converter – General considerations, Static non-idealities and Dynamic non-idealities; Current-steering DAC – Binary weighted DAC, Design issues, Effect of Mismatches. A/D converter – General considerations, static and dynamic non-idealities; Flash ADC – Basic architecture, Design issues, Comparator and Latch, Effect of non-idealities, Interpolative and folding architectures. Successive Approximation ADC; Pipeline ADC. | 7 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1.S.Franco, Design with Operational Amplifiers and Analog Integrated Circuits (3/e) TMH, 2003.<br>2.R.Gayakwad, Op-amps and Linear Integrated Circuits (4/e), PHI.<br>3.Coughlin, Op-amps and Analog Integrated Circuits, PHI. | |
| **References** | 1.D.A.Bell, Solidstate Pulse Circuits (4/e), PHI.<br>2.M.E. Van Valkenburg, Analog Filter Design, Oxford University Press, 1995.<br>3.R. Schaumann and M.E. Van Valkenburg, Design of Analog Filters, Oxford University Press, 2003.<br>4.BehzadRazavi, Principles of Data Conversion System Design, Wiley-IEEE Press, 1995.<br>5.Rudy J. van de Plassche, CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters, Springer, 2003.<br>6.Choudhury, R. and Jain, S., "Linear Integrated Circuits", 3rd Edition. | |

| SET/EI/BT/C403. MICROPROCESSORS AND MICROCONTROLLERS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Fundamentals of Microprocessors** | Fundamentals of Microprocessor Architecture. 8-bit Microprocessor and Microcontroller architecture. Internal Block Diagram of 8085 microprocessor, Introduction and architecture of to 8086 microprocessor, CPU, ALU, address, data and control bus, Working registers, Stack and Stack Pointer, Program Counter. Instruction set and simple ALP exercises. PPI 8255- architecture, programming and interfacing. | 7 |
| **The 8051 Architecture** | Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles. Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family. | 8 |
| **Instruction Set and Programming** | Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and Debugging tools. | 8 |
| **Memory and I/O Interfacing** | Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, and memory devices. | 6 |
| **External Communication Interface** | Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee. | 7 |
| **Applications** | LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, and sensor interfacing. | 7 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education, 2007.<br>2. R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996 | |
| **References** | 1. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004.<br>2. R. Kamal, "Embedded System", McGraw Hill Education, 2009.<br>3. D. A. Patterson and J. H. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Morgan Kaufman Publishers, 2013.<br>4. D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991. | |

| SET/EI/BT/C404. ANALYTICAL INSTRUMENTS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Colorimeters and Spectrophotometers** | Electromagnetic radiation, Beer Lambert law, absorption instruments, colorimeters, UV - Visible, IR spectrophotometers, general sources of error, sources of error in spectrophotometric measurements, calibration. | 7 |
| **Flame Photometer** | Principle of flame photometry, constructional details of flame photometers, clinical flame photometers, interferences in flame photometry, procedure for determinations. | 6 |
| **Atomic Absorption Spectrophotometers** | Theoretical concepts, atomic absorption instrumentation, sources of interferences. | 6 |
| **Environmental Pollution Monitoring Instruments and Gas Analyzers** | Analysis of CO, NOx, SO2, hydrocarbons. Paramagnetic oxygen analyzer, thermal conductivity analyzers. Chromatography - HPLC. | 7 |
| **Mass Spectrometers** | Basic mass spectrometer, different types of mass spectrometers, components of a mass spectrometer, resolution. | 5 |
| **Nuclear Magnetic Resonance** | Principle of NMR, constructional details of NMR spectroscopy, sensitivity enhancement for analytical NMR spectroscopy. | 5 |
| **Radiation Detectors** | Ionization chamber, GM counters, proportional counter, scintillation counter, solid state detectors. | 3 |
| **Other Instruments** | pH meters, selective-ion electrodes; Principle, construction and working of SEM, XRD. | 5 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Willard, H.H., Merit, L.L., Dean J.A. and Seattle F.L., "Instrumental Methods of Analysis", CBS Publishing and Distribution.<br>2. R S Khandpur, "Handbook of Analytical Instruments". McGraw-Hill Education. | |
| **References** | 1. Settle, F.A., "Handbook of Instrumental Techniques for Analytical Chemistry", Prentice Hall.<br>2. Skoog, D.A. and West D.M., "Principles of Instrumental Analysis". J. Chem. Educ., 1981. | |

| SET/EC/BT/C405. ELECTROMAGNETIC FIELD THEORY | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Transmission Lines** | Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines. | 6 |
| **Maxwell's Equations** | Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface. | 6 |
| **Uniform Plane Wave** | Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector. | 9 |
| **Plane Waves at Media Interface** | Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary. | 7 |
| **Waveguides** | Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides. | 7 |
| **Antennas** | Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode. | 8 |
| | **Total No. of Hours** | **43** |
| **References** | 1. R. K. Shevgaonkar, **"**Electromagnetic Waves**"**, Tata McGraw Hill, 2005.<br>2. D. K. Cheng, "Field and Wave Electromagnetics**"**, Addison-Wesley, 1989.<br>3. M. N.O. Sadiku, "Elements of Electromagnetics**"**, Oxford University Press, 2007.<br>4. C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.<br>5. C. A. Balanis, "Antenna Theory: Analysis and Design**"**, John Wiley & Sons, 2005. | |

| SET/EI/BT/C406. CIRCUIT THEORY | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Networks and Transients** | Review of Network Theorems: Thevenin's & Norton's theorem - Superposition theorem - Maximum power transfer theorem – Reciprocity Theorem - Millman's theorem; Introduction to Network Topology: Definition of basic terms – Incidence matrix – Tie-sets - Cut-sets: Analysis and formulation of network equations using tie-set and cut-set; Transients in linear circuits: Initial Conditions - Zero state response - Zero input response - Complete Response – Analysis of RC and RL circuits with impressed DC voltage – RC network as differentiator and integrator - Compensated Attenuators – DC transients in RLC circuits. | 12 |
| **S-Domain Analysis and Network Functions** | S-Domain Analysis of Circuits: Review of Laplace transform - Transformation of a circuit into S-domain - Transformed equivalent of inductance, capacitance and mutual inductance - Impedance and admittance in the transform domain - Node analysis and mesh analysis of the transformed circuit; Network functions: Impulse response and Transfer function - Poles and Zeros – Restriction of pole and zero locations of network functions - Steady state response and Frequency response from Laplace transform. | 12 |
| **Two port networks** | Characterization in terms of impedance - Admittance - Hybrid and transmission parameters - Inter relationships among parameter sets - Interconnection of two port networks - Series, parallel and cascade. Symmetrical two port networks: T and π Equivalent of a two port network.<br>Symmetrical Two Port Reactive Filters: Filter fundamentals - Pass and stop bands - Constant - k low pass filter - Constant - k high pass filter-m-derived T and π sections and their applications for infinite attenuation and filter terminations - Band pass and band elimination filters. | 11 |
| **Network Synthesis** | Synthesis: Positive real functions - Driving point functions - Brune's positive real functions - Properties of positive real functions. Testing driving point functions - Application of maximum modulus theorems - Properties of Hurwitz polynomials - Even and odd functions - Strum's theorem - Driving point synthesis - RC elementary synthesis operations - LC network synthesis - Properties of RC network functions - Foster and Cauer forms of RC and RL networks. | 9 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. D. Roy Choudhary, Network and Systems, Wiley Eastern,. | |
| **References** | 1. Van Valkenburg M E, Network Analysis 3rd Edition, Prentice Hall.<br>2. Van Valkenberg M.E., Introduction to Modern Network Synthesis, John Wiley and Sons.<br>3. Franklin. F. Kuo, Network Analysis and Synthesis, John Wiley & sons.<br>4. Hayt, Kimmerly, Engineering Circuit Analysis, McGraw Hill.<br>5. Desoer C.A. & Kuh E.S., Basic Circuit Theory, McGraw-Hill.<br>6. Ryder J.D., Networks, Lines and Fields, Prentice Hall.<br>7. B. P. Lathi, Linear Systema and Signals, Oxford University Press.<br>8. DeCarlo, R.A., & Lin, "Linear Circuit Analysis", 2 nd Edition, OUP Indian Edition 2003.<br>9. Mahmood Nahvi, Joseph, A. Edminister, "Theory and Problems of Electric Circuits – Schaum's outline series", McGraw Hill.<br>10. Donald E. Scott, "An Introduction to Circuit analysis: A System Approach" McGraw Hill Book Company.<br>11. A.Chakrabarti,"Circuit Theory" Dhanpat Rai & Co. | |

| SET/EC/BT/C407. ANALOG INTEGRATED CIRCUITS LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Differential amplifier and Current Source.<br>2. Measurement of Op-Amp parameters – CMRR, Slew rate, Open loop. Gain, input and output impedances, Unity gain bandwidth.<br>3. Inverting non-inverting amplifiers, Integrator, Differentiator – frequency response.<br>4. Instrumentation Amplifier using Op-amps and IC – Gain, CMRR and Input impedance.<br>5. Op-amp in comparator application.<br>6. Waveform Generators –Sine, square, Triangular and Ramp.<br>7. Schmitt trigger & Precision rectifiers.<br>8. Astable and Monostable Multivibrators using op-amp and 555IC.<br>9. Phase Locked Loops.<br>10. Low Pass Filter and High Pass Filter realizations using op-amps.<br>11. Band Pass Filter and Band Stop Filter realizations using op-amps.<br>12. DAC and ADC circuits using op-amp/ICs.<br>13. Regulated power supply using op amp IC and zener diode. | 15x2 |
| **Total No. of Hours** | **30** |

| SET/EI/BT/C408. MICROPROCESSORS AND MICROCONTROLLERS LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Familiarization with 8085 microprocessor kit and its keyboard.<br>2. Exercises with entry and manipulation of data (Different addressing modes).<br>3. Programming exercises using 8051 microcontroller.<br>4. Programming exercises to interface LCD with microcontroller.<br>5. Programming exercises using timers, counters, interrupts. Memory Interfacing.<br>6. Interfacing serial communication with PC using 8051.<br>7. Interfacing Stepper motor with 8051. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/EI/BT/C409. SENSORS AND TRANSDUCERS LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Displacement vs. output voltage characteristics of a LVDT.<br>2. Strain gauge characteristics.<br>3. Characteristics of RTD, Thermistor.<br>4. Hall Effect transducer.<br>5. Linear velocity measurement using proximity sensor.<br>6. Angular velocity measurement using stroboscope, tachometer.<br>7. Torque measurement. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/EI/BT/C410. ANALYTICAL INSTRUMENTS LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Study of flame photometer.<br>2. Calibration and Measurement of samples using flame photometer.<br>3. Calibration and Measurement of samples using PH meter.<br>4. Study of XRD instrument.<br>5. Study of SEM instrument.<br>6. Study of Ellipsometer instrument. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/MC/BT/M411. ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Environment, Culture, Tradition &Practices** | i) Historical overview<br>ii) Oral &codified information on medicinal Plants<br>iii) Water & Water Bodies<br>iv) Fieldwork | 5 |
| **Urbanization &Urbanism** | i) Issues of settlements & Landscapes<br>ii) Social differentiations<br>iii) Communication networks | 5 |
| **Social inequality &Gender** | i) Status within Households: An overview<br>ii) Present context<br>iii) Issues of Violence | 6 |
| **Cultural Heritage** | i) Main components<br>ii) Built Heritage<br>iii) Historical Tourism<br>iv) Cultural Forms | 8 |
| **Cultural Forms &Cultural Expressions** | i) Performing Arts<br>ii) Fairs &Festivals<br>ii) Fieldwork | 8 |
| | **Total No. of Hours** | **32** |
| **References** | 1. Indu Banga, ed. The City in Indian History: Urban Demography, Society & Polity, Delhi, Manohar,,1991<br>2. Koch, E. Mughal Art & Imperial Ideology<br>3. Radha Kumar, History of Doing: An Illustrated Account of Movements for Women's Rights &Feminism in India 1880- 1990,Zubaan, 2007<br>4. V.Vasudev, Fairs &Festivals, Incredible India Series, 2007<br>5. V.Singh, The Human Footprint on Environment: Issues in India, New Delhi, and Macmillan, 2012<br>6. B. Parikh, Composite Culture in a multicultural Society, Delhi, NBT, 2007<br>7. N. Mehta, Introduction: Satellite Television, Identity & Globalization in Contemporary India in N.Mehta, ED, Television in India, New York, Routledge, 2008<br>8. R.C. Thakran & Sheo Dutt, ed Bhartiya Upmahaduip ki Sanskritiyan, University of Delhi | |

## SEMESTER V

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C501 | Power Systems | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/EI/BT/C502 | Control Systems | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 3 | SET/EI/BT/C503 | Industrial Instrumentation | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 4 | SET/EI/BT/C504 | Power Electronics | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 5 | | PE-01 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 6 | SET/EI/BT/C506 | Power Systems Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 7 | SET/EI/BT/C507 | Control Systems Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 8 | SET/EI/BT/C508 | Industrial Instrumentation Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 9 | SET/EI/BT/C509 | Power Electronics Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 10 | SET/HS/BT/H510 | Foundations of Yoga (*HSMC) | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | | | | | | | | | | **Total** | 22 |

* Humanities and Social Sciences including Management courses.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 01 (PE-01)** | 1 | SET/EI/BT/E505 (i) | Electrical Drives |
| | 2 | SET/EI/BT/E505 (ii) | Line Commutated and Active PWM Rectifiers |
| | 3 | SET/EI/BT/E505 (iii) | Electrical Machine Design |

| SET/EI/BT/C501. POWER SYSTEMS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Characteristics of Modern Power Systems, Physical Structure, Operation and Control Functions and Hierarchies, Design and Operating Criteria. | 8 |
| **Equipment and Stability Constraints** | Capabilities and Constraints of Generators/Exciters/Turbines. Analysis of different types of transmission lines and computation of line constants/parameters, Transmission lines: Configurations, types of conductors, resistance of line, skin effect, Kelvins law, proximity effect. Elements (Lines, Transformers etc.) , Constraints of Energy Supply Systems, Load Characteristics, Introduction to Angle/Voltage Instability phenomena, Stability Constraints. | 10 |
| **Frequency and Voltage Control** | Primary Control of Frequency- Governors Secondary Control of Frequency- AGC Voltage control- Automatic Voltage Regulators (generators), Shunt Compensation, SVC. | 8 |
| **Introduction to Power Flow Control** | HVDC, FACTS Load Curves Unit Commitment Introduction to the use of Optimization Methods. | 8 |
| **Load Dispatch Centre Functions** | Contingency Analysis, Preventive, Emergency and Restorative Control. | 9 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994. | |
| **References** | 2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.<br>3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.<br>4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.<br>5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012. | |

| SET/EI/BT/C502. CONTROL SYSTEMS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Basics of Control** | Definitions of control systems, Closed loop and open loop control systems, system components - mechanical, hydraulic, pneumatic, electrical and electronic, servos and synchros, stepper motors, basic elements in control systems - open and closed loop system, electrical analogy of physical system, transfer function, mathematical modeling and transfer function of different physical systems( mechanical, pneumatic, thermal, hydraulic, electrical) block diagram, reduction techniques, signal flow graph. | 10 |
| **Time Response** | Time domain specifications, types of test inputs, I and II order system response, error coefficients, generalized error series, steady state error, PID controller response for first and second order system. | 10 |
| **Stability of Control Systems** | Characteristic equation, location of roots in S-plane for stability, Routh Hurwitz criterion, roots locus techniques. | 8 |
| **Frequency Response** | Frequency response - definition, bode plot, polar plot, gain margin and phase margin, Nyquist stability criterion and application. | 8 |
| **State space analysis** | Concepts of state, state variable and state model, state space models for linear control systems, solution of state equation, state transition matrix, concept of controllability and observability. | 8 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. I. G. Nagrath, M. Gopal, "Control Systems". Wiley, New York, 1983. | |
| **References** | 1. K. Ogata, "Modern Control Engg". PHI publications.<br>2. B. C. Kuo, "Automatic Control Systems". Prentice. Hall. | |

| SET/EI/BT/C503. INDUSTRIAL INSTRUMENTATION | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Density & Viscosity Measurement** | Density measurement - strain gauge load cell method, buoyancy method, air-pressure balance method, Gamma ray method, vibrating probe method. Viscosity measurement - units of viscosity, specific gravity scales used in petroleum industries, different methods of measuring consistency & viscosity, Saybolt, Redwood, Engler, Rotameter type, rotating cylinder, cone and plate viscometer, industrial consistency meter, rotating wane, oscillating type. | 6 |
| **Humidity and Moisture Measurement** | Humidity measurement – dry and wet psychrometer, hair hygrometer, resistance element type, saturated-salt dew-point sensor, electrolytic hygrometer, aluminium oxide sensor, quartz crystal type. Moisture measurement - thermal drying, distillation method, chemical reaction methods, electrical methods. | 6 |
| **Non - Electrical Methods of Pressure Measurement** | Different types of pressure measurement, units of pressure, manometers, elastic type of pressure gauges, bellows, diaphragms and Bourdon tubes, bell type and slack diaphragm pressure gauges. Selection of pressure gauges - testing & calibration of pressure gauges, dead weight tester, installation and maintenance of pressure gauges, differential pressure transmitters. Electrical methods of pressure measurement - pressure gauges using strain gauges, capacitive, inductive and piezo – electric. | 10 |
| **Methods of Temperature Measurements** | Temperature scales, filled-in system, liquid filled, gas filled, vapour pressure thermometer, sources of errors, compensation techniques, bimetallic thermometers. Electrical methods of temperature measurement - RTDs, industrial construction, 3/4 wire RTDs, improved bridge circuits,. Thermistors - features, construction, linearize circuits, specific applications. Thermocouples - working & construction, types of thermocouples, laws of thermocouples, cold junction, compensation methods. ICs for temperature measurements - AD590, AD 540. Pyrometers & miscellanies - basic principles, radiation pyrometer, thermal detectors, pyroelectric detectors, optical pyrometers, selection of temperature sensors. | 11 |
| **Flow Measurement** | D. P. flow meters - physical properties of flow, fundamentals of flow measurements, differential pressure flow meters - operating principle, different types, orifice, Venturi meter, pitot tube. Mechanical type flow meters - principle of operation, element of construction and application of positive displacement meters, inferential flow meter, rotameters, turbine flow meters, target flow meter. Electrical type flow meters - principle of operation, construction, applications, of electromagnetic flow meters, ultrasonic flow meters, cross correlation flow meters, vortex shedding flow meters. Mass flow meters & open channel flow measurement - conventional methods, Coriolis flow meters, angular momentum, Weirs, Flumes, guidelines for flow meters selections, calibration of flow meters. | 12 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. Doebelin E.O, “Measurement Systems: Application and Design”, McGraw Hill.<br>2. Patranabis D, “Principles of Industrial Instrumentation”, Tata McGraw Hill.<br>3. Holman, P., “Experimental Methods for Engineers”, 6th Edition, McGraw – Hill Book Coy. | |
| **References** | 1. Douglas M. Considine, “Process / Industrial Instruments & Controls Handbook”, McGraw Hill.<br>2. Eckman, D.P., “Industrial Instrumentation”, Wiley Eastern Limited.<br>3. A. K. Sswhney, “Mechanical Measurements and Instrumentation”, Dhanpat Rai & co. | |

| SET/EI/BT/C504. POWER ELECTRONICS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Characteristics of Power Devices** | Characteristics of SCR, DIAC, TRIAC, SCS, GTO, PUJT, power transistors, power FET's LASCR, two transistors model of SCR, protection of thyristors against over voltage and over current, dv/dt and di/dt. Commutation Circuits - Turn on circuits for SCR triggering with single pulse and train of pulses - synchronizing with supply, triggering with microprocessor, forced commutation - different techniques, series and parallel operation of SCR. | 16 |
| **Converter Single Φ** | Converters - single phase, half controlled and fully controlled rectifiers, waveforms of load voltage and line current under constant load current, dual converter. | 10 |
| **Inverters Single Φ** | Line commutated and forced commutated inverters, voltage source and current source inverters, parallel inverter, series inverter, PWM inverters, AC & DC choppers, step-up and step-down, cyclo converters. | 10 |
| **Applications** | AC and DC motor speed control, battery charger, switching mode power supply, uninterruptible power supply, induction and dielectric heating. | 8 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. P.S.Bhimra, Power Electronics. Khanna Publication, Delhi.<br>2. M.H. Rashid, Power Electronics. P.H.I Private Ltd. New Delhi, | |
| **References** | 1. N. Mohan, T.M. Undeland & W.P. Robbins, Power Electronics. John Wiley & Sons, Inc, 2003.<br>2. M.D. singh & K.B. Khanchandani, power electronics. Tata McGraw-Hill Education. | |

| SET/EI/BT/E505 (i). ELECTRICAL DRIVES | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **DC motor characteristics** | Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation. | 5 |
| **Chopper fed DC drive** | Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting. | 5 |
| **Multi-quadrant DC drive** | Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking. | 8 |
| **Closed-loop control of DC Drive** | Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design. | 6 |
| **Induction motor characteristics** | Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation. | 8 |
| **Scalar control or constant V/f control of induction motor** | Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation. | 6 |
| **Control of slip ring induction motor** | Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery. | 6 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989. | |
| **References** | 2**.** R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall, 2001.<br>3. G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2002.<br>4. W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001. | |

| SET/EI/BT/E505 (ii). LINE COMMUTATED AND ACTIVE PWM RECTIFIERS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Diode rectifiers with passive filtering** | Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current waveshape, effect of source inductance; commutation overlap. | 6 |
| **Thyristor rectifiers with passive filtering** | Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape. | 8 |
| **Multi-Pulse converter** | Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation. | 6 |
| **Single-phase ac-dc single-switch boost converter** | Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure. | 6 |
| **Ac-dc bidirectional boost converter** | Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure. | 8 |
| **Isolated single-phase ac-dc flyback converter** | DC-DC flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure. | 10 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988. | |
| **References** | 1. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison-Wesley, 1991.<br>2. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.<br>3. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design",John Wiley & Sons, 2007.<br>4. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2001. | |

| SET/EI/BT/E505 (iii). ELECTRICAL MACHINE DESIGN | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines. | 8 |
| **Transformers** | Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers. | 8 |
| **Induction Motors** | Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics. | 10 |
| **Synchronous Machines** | Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design. | 9 |
| **Computer aided Design (CAD)** | Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to **c**omplex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines. | 8 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970. | |
| **References** | 2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.<br>3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.<br>4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 1969.<br>5. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.<br>6. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.<br>7. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package. | |

| SET/EI/BT/C506. POWER SYSTEMS LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| Hands-on experiments related to the course contents. Visits to power system installations (generation stations, EHV substations etc.) are suggested. Exposure to fault analysis and Electro-magnetic transient program (EMTP) and Numerical Relays are suggested. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/EI/BT/C507. CONTROL SYSTEMS LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. To determine response of first order and second order systems for step input for various values of constant "K" using linear simulator unit and compare theoretical and practical results.<br>2. To study P, PI and PID temperature controller for an oven and compare their performance.<br>3. To study and calibrate temperature using resistance temperature detector (RTD).<br>4. To design Lag, Lead and Lag-Lead compensators using Bode plot.<br>5. To study behavior of separately excited dc motor in open loop and closed loop conditions at various loads.<br>6. Related Simulations using MATLAB. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/EI/BT/C508. INDUSTRIAL INSTRUMENTATION LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Determination of Discharge coefficient of Orifice plate and Venturi meter.<br>2. Measurement of flow rate using Orifice, Venturimeter, Flow nozzle and Rotameter.<br>3. Verification of Bernoulli Theorem.<br>4. Pressure gauge calibration using Dead Weight Tester.<br>5. Temperature measurement using RTD, Thermistors.<br>6. Viscosity Measurement using Falling Sphere Method. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/EI/BT/C509. POWER ELECTRONICS LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Characteristics of SCR, DIAC and TRIAC.<br>2. SCR control for AC and DC loads.<br>3. Series inverter using SCR.<br>4. Fan regulator using DIAC and TRIAC.<br>5. Parallel inverter using SCR.<br>6. AC phase control using SCR.<br>7. Study of phase splitter.<br>8. Commutative circuits. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/HS/BT/H510. FOUNDATIONS OF YOGA | | |
|---|---|---|
| **Module** | **Content** | **No. of Hrs.** |
| **General Introduction to Yoga** | Brief about origin of Yoga: Psychological aspects and Mythological concepts; History and Development of Yoga: prior to the Vedic period, Vedic period, Medival period, modern era; Etymology and Definitions of Yoga, Aim and Objectives of Yoga, Misconceptions of Yoga; Brief about Streams of Yoga; Principles of Yoga, Importance of Yoga. Ashtang Yoga. | 8 |
| **General Introduction to Indian Philosophy** | Philosophy: meaning, definitions and scope; Indian Philosophy: Salient features, Branches (Astika and Nastika Darshanas), Distinction from Religion and Science, Brief introduction to Prasthanatrayee and Purushartha Chatushtaya; Relationship between Yoga and Indian Philosophy. | 8 |
| **Brief about Yoga in texts – I** | Brief to Upanishads and Yoga in Principal Upanishads, Yoga in Yogopanishad; Yogic perspective of Epics: Ramayana and Mahabharata; Yogic perspective: Bhagavad Gita, Yoga Vasishtha. | 8 |
| **Brief about Yoga in texts – II** | Yogic perspective: Smritis, Puranas with emphasis to Bhagavat Purana; Yogic perspective to Shad-darshanas; Brief: Agamas, Tantras, Shaiva Siddhanta. | 8 |
| | **Total** | **32** |
| **Textbooks** | 1. Lal Basant Kumar : Contemporary Indian Philosophy, Motilal Banarsidas Publishers Pvt. Ltd, Delhi, 2013<br>2. Dasgupta S. N : History of Indian Philosophy, Motilal Banarsidas, Delhi, 2012<br>3. Singh S. P : History of Yoga, PHISPC, Centre for Studies in Civilization Ist, 2010<br>4. Singh S. P & Yogi Mukesh : Foundation of Yoga, Standard Publication, New Delhi, 2010 | |
| **References** | 1. Agarwal M M : Six systems of Indian Philosophy, Chowkhambha Vidya Bhawan, varanai, 2010<br>2. Swami Bhuteshananda : Nararad Bhakti Sutra, Advaita Ashrama Publication-Dept. Kolkata, II Edition, 2009<br>3. Hiriyanna M : Outlines of Indian Philosophy, Motilal Banarsidas, Delhi, 2009<br>4. Hiriyanna M: Essentials of Indian Philosophy, Motilal Banarsidas, Delhi, 2008<br>5. Radhakrishnan S: Indian Philosophy, Oxford University, UK (Vol. I & II) II Edition, 2008<br>6. Max Muller K. M : The six system of Indian Philosophy, Chukhambha, Sanskrit series, Varanasi, 6th Edition, 2008 | |

**SEMESTER VI**

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C601 | Digital Signal Processing | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/EI/BT/C602 | PLC and Automation | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 3 | SET/EC/BT/C603 | Process Control | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 4 | | PE-02 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 5 | | OE-01 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 6 | SET/EI/BT/C606 | PLC and Automation Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 7 | SET/EI/BT/C607 | Process Control Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 8 | SET/EI/BT/C608 | Seminar | - | - | - | - | - | - | 100 | 100 | 1 |
| 9 | SET/SH/BT/A609 | Biology (*HSMC) | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | | | | | | | | | | **Total** | 21 |

* Humanities and Social Sciences including Management courses.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 02 (PE-02)** | 1 | SET/EI/BT/E604 (i) | HVDC Transmission Systems |
| | 2 | SET/EI/BT/E604 (ii) | Industrial Electrical Systems |
| | 3 | SET/EI/BT/E604 (iii) | Industrial Drives and Controls |
| | 4 | SET/EI/BT/E604 (iv) | Electrical distribution System |

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Open Elective 01 (OE-01)** | 1 | SET/EI/BT/E605 (i) | Power Plant Engineering |
| | 2 | SET/EI/BT/E605 (ii) | Optical Instrumentation |
| | 3 | SET/EI/BT/E605 (iii) | Analog and Digital communication |

| SET/EC/BT/C601. DIGITAL SIGNAL PROCESSING | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Discrete Time Signals and Systems** | Discrete time signals, discrete systems, difference equations, Discrete time Fourier transform (DTFT), Properties of DTFT, frequency domain representation of LTI systems, Sampling and reconstruction of analog signals. | 4 |
| **Z- Transforms** | Bilateral z-transform, important properties of the z-transforms, inverse z-transform, system representation in the z-domain, Implementation of discrete time systems, solution of the difference equations. | 6 |
| **Discrete Fourier Transform** | Discrete Fourier transform, properties of the discrete Fourier transform, linear & circular convolution using DFT, Fast Fourier Transform algorithm, inverse DFT using FFT algorithm. | 10 |
| **Digital Filter Structures** | Characteristics of prototype analog filters, analog-to-digital filter transformations, Basic elements, IIR filter structure, FIR filter structure, lattice filter structures. | 10 |
| **Filter Design** | Design of IIR & FIR filters; Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters, properties of linear-phase FIR filters, window design techniques, Park-McClellan's method. | 12 |
| | **Total No. of Hours** | **42** |
| **References** | 1. A. Shalivahan, Digital Signal Processing; TMH.<br>2. A.V. Oppenheim & R.W. Schafer; Digital Signal Processing, Prentice Hall.<br>3. L.R. Rabiner & B. Gold; Theory and Applications of Digital Signal Processing, PHI.<br>4. A. Antoniou; Introduction of Digital Filters.<br>5. C. Emmanuel Ifeachor & W. Jervis Barrie; Digital Signal Processing, A Practical Approach.<br>6. Vinay K. Ingle & John G. Proakis ; Digital Signal Processing. | |

| SET/EI/BT/C602. PLC AND AUTOMATION | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | About PLC, History of PLC, Introduction of PLC in manufacturing unit, PLC versus computer, Basic PLC components, Basic operation of PLC system, SCADA System and DCS. | 5 |
| **PLC Hardware** | PLC hardware components- input/output modules, Processors, Power supply, Programming devices, Memory organization- AB memory organization, Logical addressing. | 8 |
| **PLC Programming** | Ladder logic diagram, Implementation of Logic gates and Boolean expressions using LLD, Seal-in Circuit, Instructions of ladder programming-relay type instruction, Program control instructions, Data Manipulation Instructions, Math Instructions. | 10 |
| **Timers and counters** | Introduction to timers and counters, Types of timers and counters, Timers and counters programming, PLC sequencer and shift registers-sequencer, synchronous and asynchronous shift register, sequencer instruction. | 14 |
| **PLC communication** | Types of communication- serial communication, industrial communication network, industrial I/O networks, different type of network communication protocol**.** | 7 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. W Bolton, "Programmable Logic Controllers". Elsevier publications.<br>2. Krishna Kant, "Computer-based Industrial Control", Prentice Hall. | |
| **References** | 1. John.W. Webb Ronald A Reis, "Programmable Logic Controllers - Principles and Applications", Prentice Hall.<br>2. Lukcas M.P, "Distributed Control Systems", Van Nostrand Reinhold Co.<br>3. Frank D. Petruzella, "Programmable Logic Controllers", McGraw Hill.<br>4. Curtis D. Johnson, "Process Control Instrumentation Technology", Prentice Hall. | |

| SET/EI/BT/C603. PROCESS CONTROL | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Process Dynamics** | Process variables, load variables, dynamics of simple pressure, flow level and temperature processes, interacting and non-interacting systems, continuous and batch process, self-regulation, servo and regulator operation, problems. | 10 |
| **Controllers and Tuning** | Basic control actions, characteristics of two position, three position, proportional, single speed floating, integral and derivative control modes, on - off, P, P+I, P+D and P+I+D control modes, problems, pneumatic, hydraulic and electronic controllers to realize various control actions. Optimum controller settings*:* Evaluation criteria, $1/4^{th}$ decay ratio, IAE, ISE, ITAE determination of optimum settings for mathematically described process using time response and frequency response, Process reaction curve method, continuous oscillation method, damped oscillation method, problems. | 14 |
| **Final control element** | I/P converter, pneumatic, electric and hydraulic actuators, valve positioner, control valves, characteristics of control valves, valve body, globe, butterfly, diaphragm, ball valves, control valve sizing, cavitations, flashing problem. | 10 |
| **Multi loop Control System** | Feed forward control, ratio control, cascade control, split range, multivariable control and examples from distillation column & boiler system. | 10 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Wayne Bequette, "Process Control – Modeling, Design and Simulation", Prentice Hall.<br>2. Stephanopoulos, "Chemical Process Control, 2nd edition, Prentice Hall.<br>3. Coughanowr, "Process Systems Analysis and Control", McGraw Hill.<br>4. Peter Harriott, "Process Control", Tata McGraw Hill. | |
| **References** | 1. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., "Process Dynamics and Control", Wiley.<br>2. Smith C.L and Corripio.A..B, "Principles and Practice of Automatic Process Control", Wiley.<br>3. Shinskey, "Process Control Systems", 4th Edition, McGraw Hill.<br>4. Paul W.Murril, "Fundamentals of Process Control Theory", ISA press.<br>5. M.Chidambaram, "Applied Process Control", Allied Publishers.<br>6. Deshpande P.B and Ash R.H, "Elements of Process Control Applications", ISA Press.<br>7. Curtis D. Johnson, "Process Control Instrumentation Technology", Prentice Hall.<br>8. D. P. Eckman, "Automatic Process Control".<br>9. Pollard, "Process Control", Heinemann Educational Books. | |

| SET/EI/BT/E604 (i). HVDC TRANSMISSION SYSTEMS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Module 1** | 1. Evolution of HVDC Transmission.<br>2. Comparison of HVAC and HVDC systems.<br>3. Type of HVDC Transmission systems.<br>4. Components of HVDC transmission systems. | 8 |
| **Module 2** | 1. Analysis of simple rectifier circuits.<br>2. Required features of rectification circuits for HVDC transmission.<br>3. Analysis of HVDC converter.<br>a. Different modes of converter operation.<br>b. Output voltage waveforms and DC voltage in rectification.<br>c. Output voltage waveforms and DC in inverter operation.<br>d. Thyristor voltages.<br>4. Equivalent electrical circuit. | 8 |
| **Module 3** | 1. HVDC system control features.<br>2. Control Modes.<br>3. Control Schemes.<br>4. Control comparisons. | 6 |
| **Module 4** | 1. Converter mal-operations.<br>2. Commutation failure.<br>3. Starting and shutting down the converter bridge.<br>4. Converter protection. | 6 |
| **Module 5** | 1. Smoothing reactor and DC Lines.<br>2. Reactive power requirements.<br>3. Harmonic analysis.<br>4. Filter design. | 6 |
| **Module 6** | 1. Component Models for the Analysis of AC DC Systems.<br>2. Power flow analysis of AC-DC systems.<br>3. Transient stability analysis.<br>4. Dynamic stability analysis. | 6 |
| **Module 7** | 1. Multi-terminal HVDC system.<br>2. Advances in HVDC transmission.<br>3. HVDC system application in wind power generation. | 4 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994. | |
| **References** | 2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.<br>3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.<br>4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.<br>5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012. | |

| SET/EI/BT/E604 (ii). INDUSTRIAL ELECTRICAL SYSTEMS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Electrical System Components** | Low voltage system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices | 8 |
| **Residential and Commercial Electrical Systems** | Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components. | 8 |
| **Illumination Systems** | Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting. | 6 |
| **Industrial Electrical Systems I** | High voltage connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components. | 8 |
| **Industrial Electrical Systems II** | DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks. | 6 |
| **Industrial Electrical System Automation** | Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation. | 8 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008. | |
| **References** | 2. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.<br>3. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.<br>4. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.<br>5. Web site for IS Standards.<br>6. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008. | |

| SET/EI/BT/E604 (iii). INDUSTRIAL DRIVES AND CONTROLS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to dc and ac motors** | Motor lead system – steady state stability criteria – Braking and speed reversal of DC and AC motors – transfer function model of separately excited and series DC motor – Equivalent circuit of Induction motor – Torque slip characteristic – Synchronous motor model. | 10 |
| **Control of dc drives** | Analysis of series and separately excited DC motor with single phase and three phase converters operating in different modes and configuration - Problems on DC machines fed by converter supplies CLC and TRC strategies. - Analysis of series and separately excited DC motors fed from different choppers, effect saturation series motors – CLC and TRC strategies – Closed loop control schemes. | 12 |
| **Control of ac drives** | Operation of Induction motor with non - sinusoidal supply wave forms, variable frequency operation of three phase Induction motors, constant flux operation, current fed operations. Dynamic and regenerative braking of CSI and VSI fed drives. Types of rotor choppers, torque equations, constant torque operations, TRC strategies, combined stator voltage control and rotor resistance control, principle of vector control – Direct and indirect FOC. | 12 |
| **Special machines** | Modeling and control schemes for PMSM, PMBLDC, stepper motor and switched reluctance motor. | 10 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Dubey, G.K., "Power Semiconductor Controlled Drives", prentice hall.<br>2. Krishnan.R., "Electrical Motor Drives-Modeling, Analysis and Control", Prentice Hall. | |
| **References** | 1. Bose.B.K. "Modern Power Electronics and AC Drives", Pearson Education, 2002.<br>2. Sheperd W., Hully L.N., "Power Electronics and Motor Control",Cambridge University press, Cambridge, 1987.<br>3. Dewan S.B., Slemon G.R., and Straughen A., "Power Semiconductor Drives", John Wiley and sons, New York, 1984.<br>4. Buxbaum A., Schierau K. and Staughen, "A Design of control system for DC drives", Springer – Verlag, Berlin, 1990.<br>5. Subharamanyam V., "Electric Drives – Concepts and Applications",Tata McGraw-Hill Publishing Co. Ltd, New Delhi 1994. | |

| SET/EI/BT/E604 (iv). ELECTRICAL DISTRIBUTION SYSTEM | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| General concepts | Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, Contribution factor loss factor-relationship between the load factor and loss factor. Classification of loads (Residential, Commercial, Agricultural and industrial) and their characteristics. | 5 |
| Distribution feeders | Design consideration of distribution feeders: Radial and loop types of primary feeders, Voltage levels, Feeder loading; Basic design practice of the secondary distribution system. Substations: location of substation, Rating of distribution substation, Service area within primary feeders. Benefits derived through optimal location of substations. | 8 |
| Underground Cables | Introduction, Insulation, Sheath, Armour and Covering, Classification of Cables, Pressurized Cables, Effective Conductor Resistance, Conductor Inductive Reactance, Parameters of Single Core Cables, Grading of Cables, Capacitance of Three Core Belted Cable, Breakdown of Cables, Cable<br>Installation, Current Rating of Cables, System Operating Problems with Underground Cables, HVDC Cables. | 10 |
| System Analysis | Voltage drop and power-loss calculations, Derivation for voltage drop and power loss in lines, Manual methods of solution for radial networks, Three phase balanced primary lines. | 10 |
| Protection | Objectives of distribution system protection, Types of common faults and procedure for fault calculations. Protective devices: Principle of operation off uses, Circuit re-closures, Line sectionalizes, and Circuit breakers. | |
| Coordination | Coordination of protective devices: General coordination procedure. Compensation for power factor improvement, Capacitive compensation for power-factor control. Different types of power capacitors, Shunt and series capacitors, Effect of shunt capacitors (fixed and switched), Power factor correction, Capacitor allocation-economic justification, Procedure to determine the best capacitor location. | 7 |
| Voltage control | Equipment for voltage control, Effect of series capacitors, Effect of AVB/AVR, Line drop compensation. | 4 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Gonen, T., Electric Power Distribution System Engineering, 3rd ed.,CRC Press 2014.<br>2. Pabla, A.S., Electric Power Distribution, 6th ed., Tata McGraw Hill, 2012. | |
| **References** | 1. Sivanagaraju, S. and Sankar, V., Electrical Power Distribution and Automation, Dhanpat Rai & Co, 2006.<br>2. Kamaraju, V., Electrical Power Distribution Systems, Tata McGraw Hill Education, New Delhi, 2011. | |

| SET/EI/BT/E605 (i). POWER PLANT ENGINEERING | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to Conventional energy Sources** | Steam, hydro, nuclear, diesel and gas, their scope and potentialities for energy conversion. Different factors connected with a generating station, load curve, load duration curve, energy load curve, base load and peak load plants. | 6 |
| **Thermal power generation** | Selection of site, size and no. of units, general layout, major parts, auxiliaries, generation costs of steam stations. | 6 |
| **Hydro power generation** | Selection of site, mass curve, flow duration curve, hydrograph, classification of hydro plants, types of hydro turbines, pumped storage plants. | 6 |
| **Nuclear power generation** | Main parts, location, principle of nuclear energy, types of nuclear reactors, reactor control, nuclear waste disposal. | 6 |
| **Power station control and interconnection** | Excitation systems and their types, excitation control, automatic voltage regulator action, interconnection of different power stations and their advantages. | 7 |
| **Economic operation of power system** | Introduction, distribution of load between units within the plant. Optimum generation scheduling considering transmission losses. | 5 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. Sam. G. Dukelow, "The Control of Boilers", 2nd Edition, ISA Press.<br>2. Gill A.B, "Power Plant Performance", Butterworth.<br>3. P.C Martin, I.W Hannah, "Modern Power Station Practice", British Electricity International Vol. 1 & VI, Pergamon Press, London, 1992. | |
| **References** | 1. David Lindsley, "Boiler Control Systems", McGraw Hill, New York, 1991.<br>2. Jervis M.J, "Power Station Instrumentation", Butterworth Heinemann, Oxford, 1993.<br>3. Modern Power Station Practice, Vol.6, "Instrumentation, Controls and Testing", Pergamon Press, Oxford, 1971. | |

| SET/EI/BT/E605 (ii). OPTICAL INSTRUMENTATION | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Fabrication of optical components** | Optical materials- properties; optical components- optical flats, wedges, mirrors, lenses, prisms, grating, compensating plates; Optical machining tools- abrasive materials, drilling, trepanning, curve generating tools. Making flats, mirrors, lenses, prisms: cutting, grinding, smoothing, surfacing, and polishing of glasses and crystals. | 6 |
| **Testing of optical components** | Refractive index measurement- glass slab, prism, Abbe's spectrometer; Wedge measurement- autocollimator, Fizeau interferometer, Measure of radius of curvature- Spherometer mothod, Newton's ring method, Rochi - grating test, Foucault-Knife edge test. Measure of flatness and surface accuracy- Principle and construction of Newton's, Fizeau, Twyman - Green interferroscope. Mach - Jehender, Michelson, Fabry - Perrot interferometer, distance measuring interferometer. | 9 |
| **Optical fibre** | Introduction to optical fibers, light guidance, acceptance angle, numerical aperture, different types of fibers, fiber losses, dispersion, manufacturing techniques, cabling, splicing, connectorization, light sources and detectors, noise, optical fibers for communication, optical fibers for instrumentation. Fiber optic sensors: Interferometer method of measurement of length, measurement of pressure, temperature, current, voltage, liquid level and strain. | 10 |
| **Lasers** | Theory of lasing action, Einstein's coefficients; He-Ne, $CO_2$ lasers, Q-switching, electro-optic, magneto-optic and acousto-optic modulators. | 10 |
| **Holography** | Theory and construction of holograms, holography and holographic interferometry, application to measurement and various physical parameters and properties. | 8 |
| | **Total No. of Hours** | **43** |
| **References** | 1. R. Hradayanath, "Optical Workshop Technology, TMH publications.<br>2. M. Silfvast, "Fundamentals of Laser", Cambridge University Press, 1996.<br>3. K. Thaigarajan & A. K. Ghatak, "Lasers: Theory and Applications".<br>4. P. Das, "Lasers and Optical Engineering". Springer.<br>5. A. K. Ghatak & K. Thaigarajan, "Optical Electronics Foundation Books".<br>6. A. Yariv, "Introduction to Optical Electronics". Holt, Rinehart and Winston, 1971.<br>7. G. P. Agrawal, "Fibre Optic Communication Systems". (Wiley Series in Microwave and Optical Engineering.<br>8. G. Keiser, "Optical Fibre Communication". McGraw-Hill. | |

| SET/EI/BT/E605 (iii). ANALOG AND DIGITAL COMMUNICATION | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Module 1** | Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals. | 10 |
| **Module 2** | Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation. | 8 |
| **Module 3** | Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers. | 10 |
| **Module 4** | Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying. | 7 |
| **Module 5** | Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation. | 8 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. Haykin S., "Communications Systems", John Wiley and Sons, 2001. | |
| **References** | 2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.<br>3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.<br>4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.<br>5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.<br>6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000. | |

| SET/EI/BT/C606. PLC AND AUTOMATION LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| Related experiments on demonstration kits and Ladder Logic Programming using simulation software. | 15x2 |
| **Total No. of Hours** | **30** |

| SET/EI/BT/C607. PROCESS CONTROL LAB | | |
|---|---|---|
| **Module** | **Content** | **No. of Hrs.** |
| **Module 1** | 1. Study of Process Control Training Plant and Compact Flow Control Unit.<br>2. Level Control and Pressure Control in Process Control Training Plant.<br>3. Study and Demonstration of Closed loop system with Disturbance.<br>4. Study and demonstration of ON/OFF, P, PI, PD and PID Controllers.<br>5. Tuning of PID Controller for mathematically described processes.<br>6. Study of complex control systems (Ratio, Feed forward, and Cascade). | 14x2 |
| | **Total No. of Hours** | **28** |

| SET/EI/BT/C608. SEMINAR | |
|---|---|
| **Content** | **No. of Hrs.** |
| Every Student shall deliver a seminar for 30 minutes. Topic for the seminar shall be decided in consultation with faculty. Topic can be related to an application or a technology which makes use of Electrical and Instrumentation engineering. Students should search for the related literature and prepare a presentation. Evaluation shall be based on content, presentation and active participation. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/SH/BT/A609. BIOLOGY | | |
|---|---|---|
| **Module** | **Content** | **No. of Hrs.** |
| **Introduction** | Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. need to study biology, Brownian motion and the origin of thermodynamics. | 3 |
| **Classification** | Hierarchy of life forms at phenomenological level, classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (f) Molecular taxonomy- three major kingdoms of life. | 4 |
| **Genetics** | Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis, how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes, single gene disorders in humans. | 4 |
| **Biomolecules** | Molecules of life: monomeric units and polymeric structures, sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids. | 4 |
| **Enzymes** | How to monitor enzyme catalyzed reactions, enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. RNA catalysis. | 4 |
| **Information Transfer** | DNA, Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code Universality and degeneracy of genetic code, gene in terms of complementation and recombination. | 4 |
| **Macromolecular analysis** | protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements. | 5 |
| **Metabolism** | Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency, breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge. | 5 |
| | **Total No. of Hours** | **33** |
| **Textbooks** | 1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.;<br>Jackson, R. B. Pearson Education Ltd. | |
| **References** | 2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons.<br>3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company.<br>4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish<br>Kumar Jain for CBS Publisher.<br>5) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers. | |

## SEMESTER VII

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C701 | Biomedical Instrumentation | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/EI/BT/C702 | Vacuum Instrumentation and Thin Film Deposition Techniques | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 3 | | PE-03 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 4 | | OE-02 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 5 | | OE-03 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 6 | SET/EI/BT/C706 | Biomedical Instrumentation Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 7 | SET/EI/BT/C707 | Vacuum Instrumentation and Thin Film Deposition Techniques Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 8 | SET/EI/BT/C708 | Project Preparation | - | - | 2 | - | - | - | - | 100 | 1 |
| 9 | SET/EI/BT/C709 | Industrial Training Seminar | - | - | - | - | - | - | - | 100 | 1 |
| 10 | SET/HS/BT/H710 | Principles of Management (*HSMC) | 3 | 1 | - | 10 | - | 30 | 70 | 100 | 3 |
| | | | | | | | | | | **Total** | 22 |

* Humanities and Social Sciences including Management courses.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 03 (PE-03)** | 1 | SET/EI/BT/E703 (i) | Electrical Energy Conservation & Auditing |
| | 2 | SET/EI/BT/E703 (ii) | Power Quality and FACTS |
| | 3 | SET/EI/BT/E703 (iii) | Control Systems II |

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Open Elective 02 and 03 (OE-02, OE-03)** | 1 | SET/EI/BT/E704 (i) | Embedded Systems |
| | | SET/EI/BT/E705 (i) | |
| | 2 | SET/EI/BT/E704 (ii) | Fuzzy Logic & Neural Network |
| | | SET/EI/BT/E705 (ii) | |
| | 3 | SET/EI/BT/E704 (iii) | Introduction to Robotics |
| | | SET/EI/BT/E705 (iii) | |
| | 4 | SET/EI/BT/E704 (iv) | Computer Architecture |
| | | SET/EI/BT/E705 (iv) | |

| SET/EI/BT/C701. BIOMEDICAL INSTRUMENTATION | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Electro physiology** | Review of physiology and anatomy, resting potential, action potential, bioelectric potentials, cardiovascular dynamics, electrode theory, bipolar and uni-polar electrodes, surface electrodes, physiological transducers. Systems approach to biological systems. | 8 |
| **Bioelectric potential and cardiovascular measurements** | EMG - Evoked potential response, EEG. ECG phonocardiography, vector cardiograph, Blood Pressure, Measurement of Blood Pressure, blood flow cardiac output, plethysmography, impedance cardiology, cardiac arrhythmia, pace makers, defibrillators. | 10 |
| **Ultrasound** | Physical principle, generation and detection of ultrasound. Application of ultrasound in bio-medical field. Block diagram of pulse-echo system. Scanner, A scan, echo-cardiograph, M-mode, B scanner, C-scan. Types of scan converter analog scan converter. Real time ultrasonic imaging systems. | 10 |
| **Imaging techniques** | Production of x-rays, block diagram of x-ray machine, x-rays Imaging techniques - CAT scan. Principle & image reconstruction techniques of NMR and MRI. | 10 |
| **Safety** | Grounding and isolation. | 6 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice Hall. | |
| **References** | 1. Geddes L. A. and Baker L. E., "Principles of Applied Biomedical Instrumentation", John Wiley.<br>2. Richard Aston, "Principles of Bio-medical Instrumentation and Measurement", Merril Publishing Company.<br>3. Kandpur R. S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill. | |

| SET/EI/BT/C702. VACUUM INSTRUMENTATION AND THIN FILM DEPOSITION TECHNIQUES | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Definitions and Gas laws** | Pressure units, gas laws, throughput and speed, kinetic theory of gases, gas pressure, mean free path, partial pressures of gases, viscosity of gases, thermal conductivity, vapour pressure, ionization, sorption and desorption, out gassing, gettering. | 4 |
| **Theory of Gaseous Flow** | Impedance, conductance, effect on pumping speed due to a component, effect of speed in a vessel due to several pumps, mechanism of gas flow, turbulent flow, viscous flow, molecular flow, transitional flow, effect of temperature and nature of gas, conductance of the components like orifice, straight pipe of finite length, annular orifice, concentric cylinders, rectangular dent, right angled bends. | 4 |
| **Vacuum Pumps** | Rotary pump: Working and characteristics, ultimate pressure, removal of vapours: chemical, physical and gas ballasting techniques. Roots pump: Working and characteristics; Diffusion pump: Working and characteristics, multistage pumps and jet design, pump fluid, self fractionalization of the pump fluid, cooling, backing and roughening requirements, speed characteristics and ultimate pressure. Sorption pumps, cryogenic pumps, ion pumps, getter pumps, sputter-ion pumps, turbo-molecular pumps- their characteristics, merits and limitations. | 8 |
| **Measurement of Vacuum** | Mc Leod gauge, thermo conductivity gauges: Pirani, thermocouple. Ionization gauges; Penning gauge, hot cathode ionization gauge, Bayard Alpert gauge; capacitance gauges. Calibration of gauges. | 5 |
| **Vacuum Materials** | Properties of vacuum materials; vapour pressure, out gassing, permeability, mechanical strength. Seals: demountable, permanent, elastomers, metal gaskets, glass to metal seals, ceramic to metal seals. Vacuum grease, oils, cement and waxes. Idea of designing of a vacuum system. | 5 |
| **Leak Detection** | Bubble, soap solution, spark coil, discharge tube, ultrasonic, dye penetration, thermal conductivity and mass spectrometer methods. | 3 |
| **Physical Methods of Thin Film Deposition** | Basic idea of evaporation method: source materials, resistive evaporation, electron beam evaporation, flash evaporation, laser ablation, reactive evaporation. Sputtering: DC, bias, triode, rf, magnetron, ion beam sputtering, ion plating, MBE. | 5 |
| **Chemical Methods of Thin Film Deposition** | Basic idea of Electrolytic, electroless, anodization, sol-gel, spray pyrolysis, CVD, Plasma CVD. | 4 |
| **Film Thickness Measurement & Characterization** | In situ monitoring and post deposition methods, mechanical, micro balance, electrical resistance, capacitance, ionization, quartz crystal method. | 4 |
| | **Total No. of Hours** | **42** |
| **References** | 1. A. Roth, "Vacuum Technology", North Holland.<br>2. Nigel Harris, "Modern Vacuum Practice".<br>3. Hablanian, "High Vacuum Technology" - A Practice Guide. | |

| SET/EI/BT/E703 (i). ELECTRICAL ENERGY CONSERVATION AND AUDITING | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Energy Scenario** | Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features. | 7 |
| **Basics of Energy and its various forms** | Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion. | 7 |
| **Energy Management & Audit** | Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding<br>energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams. | 7 |
| **Energy Efficiency in Electrical Systems** | Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors. | 7 |
| **Energy Efficiency in Industrial Systems** | Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control<br>strategies and energy saving opportunities, assessment of cooling towers. | 8 |
| **Energy Efficient Technologies in Electrical Systems** | Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology. | 6 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991. | |
| **References** | 1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects.<br>2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities.<br>3. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org) | |

| SET/EI/BT/E703 (ii). POWER QUALITY AND FACTS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Transmission Lines and Series/Shunt Reactive Power Compensation** | Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation. | 4 |
| **Thyristor-based Flexible AC Transmission Controllers (FACTS)** | Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter. | 6 |
| **Voltage Source Converter based (FACTS) controllers** | Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter. | 8 |
| **Application of FACTS** | Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM. | 5 |
| **Power Quality Problems in Distribution Systems** | Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve. | 5 |
| **DSTATCOM** | Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM. | 8 |
| **Dynamic Voltage Restorer and Unified Power Quality Conditioner** | Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies. | 6 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1999. | |
| **References** | 2. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.<br>3. T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 1983.<br>4. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.<br>5. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991 | |

| SET/EI/BT/E703 (iii). CONTROL SYSTEMS II | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Review of State Space analysis** | Concepts of state space and state variables. State space representation of systems described by scalar differential equations, solution of state equation; State transition matrix. State space representation of discrete systems, Controllability and observability of linear time invarient systems; conditions for complete controllability and complete observability. | 16 |
| **Stability Analysis** | Definition, first and second methods of Liapunov: stability analysis of linear system using Liapunov's second method. Stability analysis of Nonlinear system using second method of Liapunov – Liapunov's stability theorem, Generation of V-function using some formalized methods, Minimization of Vfunction, Computation of stability domain, Popov's stability criterion, Study of stability of Lur'e system using Liapunov – Popov method & exploiting the use of YKM – lemma. | 8 |
| **Non-linear Systems** | Introduction: Common physical non-linearities: Phase-plane method, system analysis by phase plane method: Describing functions: Stability analysis by describing function methods. | 8 |
| **Sampled Data Systems** | Sampling process: Impulse modulation: Mathematical analysis of sampling process; Z transform and its evaluation, theorems of Z-transform: Modified Z- transform: Mapping of S-Plane into Z plane, pulse transfer function: stability analysis in Z-plane using various methods.<br>Introduction to Adaptive Control and Parameter Identification. | 12 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Ogata K, "Modern Control Engineering", PHI 4th Ed., New Delhi (2002).<br>2. Gibson J E, "Non Linear automatic Control", MGH (Int.) (1966).<br>3. Lindorf D P, "Theory of sampled data control systems", JW (1967). | |
| **References** | 1. Atherton D P, "Non linear control engineering", Van Nostrand Reinhold, London (1975).<br>2. Kuo B C, "Analysis & Synthesis of S.D. Control Systems", PHI, New Delhi (1966). | |

| SET/EI/BT/E704 (i). EMBEDDED SYSTEMS<br>SET/EI/BT/E705 (i). EMBEDDED SYSTEMS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Overview, Characteristics of Embedding Computing Applications: Concept of Real time Systems, Challenges in Embedded System Design, Design Process, Requirements, Specifications, Architecture Design, Designing of Components, System Integration | 4 |
| **Embedded System Architecture** | Instruction Set Architecture: CISC and RISC, Basic Embedded Processor/Microcontroller Architecture: CISC Example: 8051, RISC Example: ARM , DSP Processors, Harvard Architecture, PIC, Memory System Architecture : Caches, Virtual Memory, Memory Management Unit and Address Translation, I/0 Sub-system, Busy-wait I/0, DMA, Interrupt driven I/0, Co-processors and Hardware Accelerators, Processor Performance Enhancement, Pipelining. | 5 |
| **Designing Embedded Computing Platform** | Using CPU Bus: Bus Protocols ,Bus Organization, Memory Devices and their Characteristics, RAM, ROM, UVROM, EEPROM, Flash Memory, DRAM, I/O Devices, Timers and Counters, Watchdog Timers, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards, Infrared devices, Component Interfacing, Memory Interfacing, I/O Device Interfacing, Interfacing Protocols, GPIB, FIREWIRE, USB, IRDA, Designing with Processors, System Architecture, Hardware Design, FPGA Based Design, Implementation Development Environment, Debugging Techniques, Manufacturing and Testing, Design Examples, Data Compressor, Alarm Clock | 7 |
| **Programming Embedded Systems** | Program Design, Design Patterns for Embedded Systems, Models of Program, Control and Data flow Graph, Programming Languages, Desired Language Characteristics, Introduction to Object Oriented Programming, Data Typing, Overloading and Polymorphism, Control, Multi-tasking and Task Scheduling, Timing Specifications, Run-time Exception handling, Use of High Level Languages, C for Programming embedded systems, Use of Java for Embedded Systems, Programming and Run-time Environment, Compiling, Assembling, Linking, Debugging, Basic Compilation Techniques, Analysis and Optimization of Execution Time, Analysis and Optimization of Energy and Power, Analysis and Optimization of Program Size, Program Validation and Testing | 8 |
| **Operating System** | Basic Features of an Operating System , Kernel Features, Real-time Kernels, Polled Loops System, Co-routines, Interrupt-driven System, Multi-rate System, Processes and Threads, Context Switching, Cooperative Multi-tasking, Pre-emptive Multi-tasking, Scheduling, Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling, Task Assignment, Fault-Tolerant Scheduling, nter-process Communication, Signals, Shared Memory Communication, Message-Based Communication, Real-time Memory Management, Process Stack Management, Dynamic Allocation, I/O, Synchronous and Asynchronous I/O, Interrupt Handling, Device Drivers, Real-time OS, VxWorks, RT-Linux, Evaluating and Optimizing Operating System Performance, Response-time Calculation, Interrupt latency, Time-loading, Memory Loading, Power Optimization Strategies for Processes. | 10 |
| **Network Based Embedded Applications** | Network Fundamentals, Layers and Protocols, Network Architectures, Network Components: Bridges, Routers, Switches, Distributed Embedded Architectures, Elements of Protocol Design, High Level Protocol Design Languages, Network Based Design, Internet-Enabled Systems, Protocols for industrial and control applications, Internetworking Protocols, Wireless Applications, Blue-tooth | 4 |
| **Embedded Control Applications** | Introduction, Open-loop and Closed Loop Control Systems, Examples: Speed Control, PID Controllers, Software Coding of a PID Controller. | 3 |
| **Embedded System Development** | Design Methodologies, UML as Design tool, UML notation, Requirement Analysis and Use case, Modeling, Static Modeling, Object and Class Structuring, Dynamic Modeling, Architectural Design, Hardware-Software Partitioning, Hardware-Software Integration, Design Examples, Inkjet Printer, Set-top Box. | 3 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. John B. Peatman : Design with Microcontrollers, TMH. | |
| **References** | 1. Tim Wilmshurst, An introduction to the design of small-scale embedded systems, Palgrave.<br>2. Jack Ganssle. The Art of Designing Embedded Systems, Elsevier, 1999.<br>3. J.W. Valvano, Embedded Microcomputer System: Real Time Interfacing, Brooks/Cole, 2000.<br>4. R. Gupta, Co-synthesis of Hardware and Software for Embedded Systems, Kluwer 1995.<br>5. Intel : 8 Bit Embedded Controller Hand Book.<br>6. Intel : 16 Bit Embedded Controller Hand Book.<br>7. Web : http://nptel.ac.in/courses/108102045/ | |

| SET/EI/BT/E704 (ii). FUZZY LOGIC & NEURAL NETWORK<br>SET/EI/BT/E705 (ii). FUZZY LOGIC & NEURAL NETWORK | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | History of development in neural networks, neural network characteristics, Artificial neural network technology, Model of a neuron, topology, learning, types of learning, supervised, unsupervised and reinforcement learning. | 6 |
| **Supervised Learning** | Basic hop field model, the perceptron, linear reparability, Basic learning laws, Hebb's rule, Delta rule, Widroff and Huff LMS learning rule, correlation learning rule, In star and out star learning rules. Unsupervised learning, competitive learning, K mean clustering algorithm, Kolwner's feature maps. | 8 |
| **Training Algorithms** | Single layer perceptron and Multilayer feedforward networks, Back propagation training for multi layer feedforward networks , Basic learning laws in RBF network, recurrent networks, recurrent back propagation, Real time recurrent learning algorithm. | 5 |
| **Counter Propagation Networks** | Introduction to counter propagation networks, CMAC networks, ART networks, Application of neural networks, pattern recognition, optimization, associative memory networks, vector quantization, control. | 6 |
| **Fuzzy Logic** | Basic concepts of fuzzy logic, Fuzzy logic crisp set, Linguistic variable, Membership functions, fuzzy set theory and their Operation including addition, subtraction, multiplication and division, Fuzzy IF THEN rules, fuzzy relations, Variable inference techniques, Defuzzification techniques, Basic fuzzy inference algorithm, Application of fuzzy logic, Fuzzy system design, Implementation of fuzzy system, Useful tools supporting design. | 10 |
| **Neural and Fuzzy Control** | Fuzzy controller design, Classification of Control Systems, Neural Networks in direct and indirect control. | 8 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. Riza Berkin and Trubatch, "Fuzzy System Design Principles", PHI (2000).<br>2. Yegna Narayenan, "Artificial Neural Networks", MGH (1999).<br>3. Bart Kosko, "Nueral Networks and Fuzzy Logic", PHI, New Delhi (1998). | |
| **References** | 1. Simon Haykin, "Neural Networks", Pearson Education (2002).<br>2. Anderson J A "An Introduction to Neural Networks", PHI, New Delhi (1998). | |

| SET/EI/BT/E704 (iii). INTRODUCTION TO ROBOTICS<br>SET/EI/BT/E705 (iii). INTRODUCTION TO ROBOTICS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Module 1** | History, Robots, Industrial robots and their applications: robot subsystems, classification of robots, industrial applications. | 8 |
| **Module 2** | Actuators and Grippers: Electric actuators, Hydraulic actuators, Pneumatic actuators, Selection of motors, grippers, Sensor classification, Internal and External sensors, | 10 |
| **Module 3** | Transformations: robot architecture, pose of a rigid body, Coordinate transformation, forward and inverse position analysis. | 8 |
| **Module 4** | Statics and Manipulator Design: Forces and moments balance, Role of Jacobian in statics, manipulator design. | 8 |
| **Module 5** | Inertia properties, Eular-Lagrange Formulation, Newton-Eular Formulation, Dynamic modeling. Control Techniques, Nonlinear and force control. | 9 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. Introduction to robotics, S. K. Saha, Tata McGraw-Hill Education<br>2. Fundamentals of mechanics of robotic manipulation, Marco Ceccarelli, Springer Science. | |
| **References** | 3. Elements of robotics, Mordechai Ben-Ari, Francesco Mondada, Springer. | |

| SET/EI/BT/E704 (iv). COMPUTER ARCHITECTURE<br>SET/EI/BT/E705 (iv). COMPUTER ARCHITECTURE | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Introduction and overview of computer architecture, basic computer organization, register transfer notation. General aspects of processor design, CPU organization, instruction set architecture, data types, addressing modes, program sequencing. | 5 |
| **Instructions and Assembly language Programming** | Direct, indirect, indexed, relative and immediate addressing mode. Pre and post indexing, instruction formats, zero, one, two and three address machine, different types of instructions – memory and non memory reference instructions; Assembly language – Basic I/O operations – Stacks and Queues; Assembler, Compiler, Linker. | 6 |
| **Arithmetic** | Basic structure functional blocks, register involved, fetch and execution cycle, instruction sequencing; ALU design: computer arithmetic, fixed and floating points arithmetic, logical operations; design of fast adders, multiplication and division circuits. | 6 |
| **Control unit** | Control unit concepts, execution of complete instructions, and sequencing of control signals, hardware control unit, general micro-programming concepts, micro-programmed control unit, micro-instructions and their encoding. | 6 |
| **Pipelined processing** | Pipelining, Basic Concepts, Data hazards, Instruction hazards, Influence on Instruction sets; Data path and control consideration – Superscalar operation. | 5 |
| **Memory System Design** | Memory hierarchy, system balance consideration, Speed, size and cost; memory I/O design, cache, ROM, Performance consideration, Virtual memory, Memory management requirements, Secondary storage. | 6 |
| **Input-Output Organization** | Addressing I/O devises, data transfer synchronization, interrupt handling, I/O channels, computer peripherals and interfacing, I/O interfaces I/O devices, terminals, card readers, and I/O processors, Standard I/O Interfaces (PCI, SCSI, and USB). | 5 |
| **Programmable Logics and HDL** | Introduction to CPLDs and FPGAs; Introduction to VHDL and different styles of modeling; VHDL programs for adders, decoder, encoder, 7-segment display decoder, multiplexer, de-multiplexer, up down counter, universal shift register, ALU, Melay and Moore type FSM sequence detector; | 6 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. Moris M Mano, "Computer System Architecture", PHI.<br>2. Roth, "Digital Design using VHDL" | |
| **References** | 1. Hennesy, Patterson, "Computer Organization and Design: the hardware/ software interface", Morgan Kauffman.<br>2. Hamacher, C., Vranesic, Z. and Zaky, S., "Computer Organization" McGraw Hill. | |

| SET/EI/BT/C706. BIOMEDICAL INSTRUMENTATION LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Study of electrodes.<br>2. Measurement of BP.<br>3. Measurement of PH.<br>4. Study of EEG, ECG, CAT-SCAN.<br>5. Visit to Pathological Lab.<br>6. Hospital visit to see demonstration of EEG, ECG, and CAT-SCAN.<br>7. MATLAB Simulation for biomedical signal analysis. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/EI/BT/C707. VACUUM INSTRUMENTATION AND THIN FILM DEPOSITION TECHNIQUES LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Study of rotary pump.<br>2. Study of diffusion pump.<br>3. Study of LPCVD setup.<br>4. Study of Oven.<br>5. Creating a vacuum.<br>6. Measurement of Vacuum/ low pressure.<br>7. Deposition of thin film.<br>8. Characterization of thin film properties. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/EI/BT/C708. PROJECT PREPARATION | |
|---|---|
| **Content** | **No. of Hrs.** |
| Project Preparation includes following assignments.<br>• Survey and study of published literature on the assigned topic;<br>• Working out a preliminary approach to the Problem relating to the assigned topic;<br>• Conducting Preliminary Analysis/ Modeling/ Experiment/ Simulation/ Experiment/ Design/ Feasibility<br>• Preparing a Written Report on the Study conducted for presentation to the Department;<br>• Final Seminar, as oral Presentation before a Departmental Committee. | 24x2 |
| **Total No. of Hours** | **48** |

| SET/EI/BT/C709. INDUSTRIAL TRAINING SEMINAR | |
|---|---|
| **Content** | **No. of Hrs.** |
| Student shall prepare a detailed report on her/his industrial training and deliver a seminar of 30 minutes. | 24x2 |
| **Total No. of Hours** | **48** |

| SET/HS/BT/H710. PRINCIPLES OF MANAGEMENT | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **General Management** | Nature, scope and significance of management. Process and functions of management. Overview of the functional areas of the general management. | 6 |
| **Financial Management** | Traditional and modern concept of finance function, nature, scope and significance of finance and financial management, functions of financial managers and financial decisions, financial environment. | 6 |
| **Marketing Management** | Nature, concept, scope and significance of marketing management, functions of marketing management, marketing planning and marketing mix. | 6 |
| **Product Development** | Concept, nature, significance of product management, product value, types of products, new product development, product life cycle, functions of product managers. | 6 |
| **Human Resource Management** | Concept, nature, scope, importance of human factor in managing modern organizations, functions of human resource mangers; Planning, organizing, directing, motivation, control and co-ordination. | 6 |
| **Operations Management** | Concept of operations management, tools and techniques: PERT, CEPM, JIT, KANBAN, Inventory management, six sigma, TQM, SCM; | 6 |
| **Production Management** | Concept, nature and significance of production management, functions of production managers. | 6 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. B. S. Goyal, "Production and Operations Management", Pragati Prakashan, 2002. | |
| **References** | 1. O. D. W. Koontz, "Elements of Management", Tata McGraw Hill.<br>2. T. N. Chabara, "Principles and Practice of Management", Dhanpat Rai & Co.<br>3. M. Y. Khan, "Financial Management", Tata McGraw-Hill.<br>4. I. M. Pandey, "Financial Management", Vikas Publishing.<br>5. P. Kotler, Marketing Management: Analysis", The Prentice-Hall.<br>6. E. B. Flippo, "Principles of Personnel Management", New York, McGraw-Hill. | |

## .SEMESTER VIII

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | PE-04 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | | OE-04 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 3 | | OE-05 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 4 | SET/EI/BT/C804 | Major Project | - | - | 16 | - | - | - | - | 100 | 8 |
| | | | | | | | | | | **Total** | 17 |

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 04 (PE-04)** | 1 | SET/EI/BT/E801 (i) | Renewable Energy Engineering |
| | 2 | SET/EI/BT/E801 (ii) | Electrical Distribution System |
| | 3 | SET/EI/BT/E801 (iii) | Control Systems Design |
| | 4 | SET/EI/BT/E801 (iv) | Switchgear and Protection |

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Open Elective 04 and 05 (OE-04, OE-05)** | 1 | SET/EI/BT/E802 (i) | Data Communication and Networking |
| | | SET/EI/BT/E803 (i) | |
| | 2 | SET/EI/BT/E802 (ii) | Virtual Instrumentation |
| | | SET/EI/BT/E803 (ii) | |
| | 3 | SET/EI/BT/E802 (iii) | Smart Grid Technology |
| | | SET/EI/BT/E803 (iii) | |
| | 4 | SET/EI/BT/E802 (iv) | Mobile Communication and Networks |
| | | SET/EI/BT/E803 (iv) | |

***** The Major Project(s) will be evaluated on the basis of the weightage of 20% of Report writing, 50% of the Project work and 30% for Presentation and Viva. There shall be two presentations for each Project evaluation and at least one outside expert will be the member of the evaluation committee for final evaluation.

| SET/EI/BT/E801 (i). RENEWABLE ENERGY ENGINEERING | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Energy sources and their availability- conventional and renewable energy sources, prospects of renewable energy. Energy conservation and energy audit. | 4 |
| **Solar Energy** | Solar radiation and its measurement, solar constant, solar radiation at earth's surface, solar radiation geometry, estimation of average solar radiation, solar radiation at tilted surfaces. Photo-thermal conversion- Physical principles of solar radiation into heat, solar energy collectors- flat plate and focusing type, energy balance equation and collector efficiency, Selective absorbing coatings. Useful heat gained by collector fluid. Solar energy storage systems- solar ponds and extraction of thermal energy. Applications of photo-thermal energy- in agriculture, distillation, pumping cooking, green houses, hydrogen production, etc. Solar photo-voltaic: Principle and materials, solar cells, their combination, storage of photovoltaic energy. | 8 |
| **Wind Energy** | Nature of wind, power of wind, forces on rotor blades, wind energy conversion, energy estimation, site selection considerations, basic components of wind energy conversion system, types of wind machines- horizontal axial and vertical axial machines, aerodynamic forces acting on blades, scheme of electricity generation, generator control, load control, energy storage, applications of wind energy. | 8 |
| **Energy from Biomass** | Biomass conversion technologies- wet and dry processes, photosynthesis, biogas plants, fuel properties of biogas, thermal gasification of biomass. | 4 |
| **Geothermal energy** | Nature of geothermal fields, geothermal sources, energy estimation, application of geothermal energy, materials selection for geothermal power plants. | 4 |
| **Ocean energy** | Ocean thermal energy conversion (OTEC)- open cycle and close cycle OTEC, site selection, energy utilization, energy from tides, components of tidal power plants, Ocean wave energy- Energy conversion devices. | 4 |
| **Mini and micro hydro** | Components, turbine and generators for small scale hydro, protection, control and management of equipments. | 4 |
| **Chemical energy sources** | Fuel cells, design and principle, types, conversion efficiency, types of electrodes, work output and EMF of fuel cells. Batteries- basic theory, types, characteristics, different batteries arrangements. Hydrogen energy- methods of hydrogen production, hydrogen storage, hydrogen as an alternative fuel, safety and management. | 6 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. D. P. Kothari, “Renewable Energy Resources”, PHI Publications. | |
| **References** | 1. G. D. Rai, “Non- conventional sources of energy”, Khanna Publishers, Delhi. | |

| SET/EI/BT/E801 (ii). ELECTRICAL DISTRIBUTION SYSTEM | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **General concepts** | Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, Contribution factor loss factor-relationship between the load factor and loss factor. Classification of loads (Residential, Commercial, Agricultural and industrial) and their characteristics. | 5 |
| **Distribution feeders** | Design consideration of distribution feeders: Radial and loop types of primary feeders, Voltage levels, Feeder loading; Basic design practice of the secondary distribution system. Substations: location of substation, Rating of distribution substation, Service area within primary feeders. Benefits derived through optimal location of substations. | 6 |
| **Underground Cables** | Introduction, Insulation, Sheath, Armour and Covering, Classification of Cables, Pressurized Cables, Effective Conductor Resistance, Conductor Inductive Reactance, Parameters of Single Core Cables, Grading of Cables, Capacitance of Three Core Belted Cable, Breakdown of Cables, Cable<br>Installation, Current Rating of Cables, System Operating Problems with Underground Cables, HVDC Cables. | 14 |
| **System Analysis** | Voltage drop and power-loss calculations, Derivation for voltage drop and power loss in lines, Manual methods of solution for radial networks, Three phase balanced primary lines. | 4 |
| **Protection** | Objectives of distribution system protection, Types of common faults and procedure for fault calculations. Protective devices: Principle of operation off uses, Circuit re-closures, Line sectionalizes, and Circuit breakers. | 5 |
| **Coordination** | Coordination of protective devices: General coordination procedure. Compensation for power factor improvement, Capacitive compensation for power-factor control. Different types of power capacitors, Shunt and series capacitors, Effect of shunt capacitors (fixed and switched), Power factor correction, Capacitor allocation-economic justification, Procedure to determine the best capacitor location. | 8 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. Gonen, T., Electric Power Distribution System Engineering, 3rd edition CRC Press 2014.<br>2. Pabla, A.S., Electric Power Distribution, 6th ed., Tata McGraw Hill, 2012. | |
| **References** | 1. Sivanagaraju, S. and Sankar, V., Electrical Power Distribution and Automation, Dhanpat Rai & Co, 2006.<br>2. Kamaraju, V., Electrical Power Distribution Systems, Tata McGraw Hill Education, New Delhi, 2011. | |

| SET/EI/BT/E801 (iii). CONTROL SYSTEMS DESIGN | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Design Specifications** | Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response. | 10 |
| **Design of Classical Control System in the time domain** | Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators. | 6 |
| **Design of Classical Control System in frequency domain** | Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram. | 6 |
| **Design of PID controllers** | Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control. | 6 |
| **Control System Design in state space** | Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of<br>Observer. Reduced order observer. Separation Principle. | 10 |
| **Nonlinearities and its effect on system performance** | Various types of non-linearities. Effect of various non-linearities on system performance. Singular points. Phase plot analysis. | 4 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. N. Nise, "Control system Engineering", John Wiley, 2000. | |
| **References** | 2. I. J. Nagrath and M. Gopal, "Control system engineering", Wiley, 2000.<br>3. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.<br>4. K. Ogata, "Modern Control Engineering", Prentice Hall, 2010.<br>5. B. C. Kuo, "Automatic Control system", Prentice Hall, 1995.<br>6. J. J. D'Azzo and C. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill, 1995.<br>7. R. T. Stefani and G. H. Hostetter, "Design of feedback Control Systems", Saunders College Pub, 1994. | |

| SET/EI/BT/E801 (iv). SWITCHGEAR AND PROTECTION | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Faults in Power Supply System** | Symmetrical component transformation. Three phase power in unbalanced circuit in terms of symmetrical component. Sequence impedance of generator. Transformer transmission line & passive loads. Phase shift in Y/delta three phase transformers (Yd1, Yd11 connection). Symmetrical fault analysis without & with pre-fault load currents. Selection of circuit breakers ratings, current limiting reactors. | 10 |
| **Unsymmetrical fault analysis** | L-G, L-L-G-, L-L, open conductors fault using symmetrical components. | 4 |
| **General philosophy of protective relaying** | Protective zones. Primary protection, back up protection, remote and local back up, selectivity. Medium voltage line protection: over current relaying directional over current relays. | 6 |
| **High voltage line protection** | Distance relays, carrier distance schemes. Unit carrier schemes. | 2 |
| **Equipment protection** | Principles of differential relaying, protection of generator, transformers and busbars by differential relaying and other relays. Protection of induction motor‘s against overload, short-circuits, thermal release, miniature circuit breaker. | 6 |
| **Introduction to numerical relays** | Comparison of static and electro-mechanical relays, two input amplitude and phase comparators and their duality. Generation of various distance relay characteristics using above comparators. Switchgear: circuit breakers, arc interruption theory, recovery. | 8 |
| **Switchgear** | circuit breakers, arc interruption theory, recovery and restriking voltages, RRRV, breaking of inductive and capacitive current, C.B. ratio, different media of arc interruption, SF6 and vacuum breakers. | 6 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. Ram, B. and Vishwakarma, D.N. Power System Protection & Switchgear,2nd ed., Tata McGraw Hill, 2013.<br>2. Paithankar, Y.G. and Bhide, S.R., Fundamentals of Power System Protection, 2nd ed., PHI Learning, 2013 | |
| **References** | 1. Elmore, W.A, Protective Relaying Theory and Applications, 2nd ed., MarcelDekker, New York, 2004.<br>2. Mason, C.R., Art and Science of Protective Relaying, Wiley, New York, 1968.<br>3. Warrington, A.R.V., Protective Relays: Their Theory and Practice (Vol. I & Vol. II), 3rd ed., Chapman and Hall, London, 1978. | |

| SET/EI/BT/E802 (i). DATA COMMUNICATION AND NETWORKING<br>SET/EI/BT/E803 (i). DATA COMMUNICATION AND NETWORKING | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to networks** | Networks: Components and Categories, Types of Connections,Topologies, Transmission Media, Coaxial Cable, Fiber Optics, ISO/OSI Model. | 8 |
| **Data link layer** | Error- Detection and correction, Parity, LRC, CRC, Hamming code, Low Control and Error control, Stop and wait, ARQ, Sliding window, HDLC, LAN, IEEE 802 Standards, Wireless LAN, Bridges. | 8 |
| **Network layer** | Inter-networks, Packet Switching and Datagram approach, IP addressing methods, Sub-netting, Routing, Distance Vector Routing, Link State Routing, Routers. | 8 |
| **Transport layer** | Duties of transport layer, Multiplexing, De-multiplexing, Sockets, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Congestion Control, Quality of Services (QOS) | 8 |
| **Application layer** | Domain Name Space (DNS), SMTP, FTP, HTTP –WWW, Network Security. | 4 |
| **Industrial Data Networks** | RS – 232 AND RS – 485, 20ma current loop – Serial interface converters; MODBUS protocol, Data highway (plus) protocol; HART Protocol; Introduction to AS–interface and Device-Net; Introduction to Profibus; Foundation field bus versus Profibus;<br>10Mbps Ethernet; 100Mbps; | 6 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. Behrouz A. Forouzan, “Data communication and Networking”. Tata McGrawHill, 2004<br>2. Mackay, S., Wrijut, E., Reynders, D. and Park, J., “Practical Industrial DataNetworks Design, Installation and Troubleshooting”, Newnes Publication,Elsevier, 1st Edition, 2004. | |
| **References** | 1. Andrew S. Tanenbaum, “Computer Networks”. PHI, Fourth Edition, 2003.<br>2. William Stallings, “ Data and Computer Communication”, Sixth Edition, PearsonEducation<br>3. Leon-Garcia, Widjaja: Communication Networks, TMH.<br>4. Buchanan, W., “Computer Busses”, CRC Press, 2000<br>5. Stallings, W., “Wireless Communication and Networks”, 2nd Edition, PrenticeHall of India. | |

| SET/EI/BT/E802 (ii). VIRTUAL INSTRUMENTATION<br>SET/EI/BT/E803 (ii). VIRTUAL INSTRUMENTATION | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Virtual Instrumentation** | Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, and comparison with conventional programming. Introduction to LabView. Tools Palette , Controls Palette Controls and Indicators Numeric Controls and Indicators Boolean Controls and Indicators Configuring Controls and Indicators, Functions Palette | 9 |
| **VI programming techniques** | VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web. | 8 |
| **Data acquisition basics** | Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements. | 8 |
| **VI Chassis requirements** | Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI. | 8 |
| **Applications** | VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control. | 9 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. Nadovich, C., "Synthetic Instruments Concepts and Applications", Elsevier.<br>2. Gary Johnson, "LabVIEW Graphical Programming", McGraw Hill.<br>3. Lisa K. wells & Jeffrey Travis, "LabVIEW for everyone", Prentice Hall.<br>4. Jane W. S. Liu, "Real-time Systems", Pearson Education.<br>5. Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready-to-use Modules in C", CMP Books. | |
| **References** | 1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes.<br>2. Jean J. Labrosse, "MicroC/OS-II. The Real-time Kernal", CMP Books.<br>3. Buchanan, W., "Computer Busses", CRC Press, 2000.<br>4. www.ni.com.<br>5. www.ltrpub.com. | |

| SET/EI/BT/E802 (iii). SMART GRID TECHNOLOGY<br>SET/EI/BT/E803 (iii). SMART GRID TECHNOLOGY | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Module 1** | Review of basic elements of electrical power systems, Desirable traits of a modern grid, Principal characteristics of the smart grid, Key technology areas; Smart grid communication: Two way digital communication paradigm, network architectures, IP-based systems, Power line communications, Advanced metering infrastructure; Renewable generation: Renewable resources: Wind and solar, Microgrid architecture, Tackling intermittency, Distributed storage and reserves; Wide area measurement: Sensor networks, Phasor measurement units, Communications infrastructure, Fault detection and Self-healing systems, Application and challenges; Security and privacy: Cyber security challenges in smart grid, Defense mechanism, Privacy challenges. | 43 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. J. Momoh , Smart Grid: Fundamentals of Design and Analysis‘ Wiley-IEEE Press, 2012. | |
| **References** | 1. P. F. Schewe, The Grid: A Journey through the Heart of our Electrified World‘Joseph Henry Press, 2006.<br>2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama _Smart Grid: Technology and<br>Applications‘Wiley press, 2012.<br>3. Ali Keyhani, Design of smart power grid Renewable Energy Systems‘2nd Edition Wiley-IEEE Press, 2011. | |

| SET/EI/BT/E802 (iv). MOBILE COMMUNICATION AND NETWORKS<br>SET/EI/BT/E803 (iv). MOBILE COMMUNICATION AND NETWORKS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Module 1** | Introduction to RF propagation, multi-path fading, mobile channel description and analysis, RF circuits and systems | 8 |
| **Module 2** | Mobile communication concepts, cellular engineering, cellular concepts, frequency allocation, spectrum efficiency, speech coding, modulation/demodulation techniques, multiple access techniques-FDMA, TDMA, CDMA, Spread Spectrum Techniques. | 12 |
| **Module 3** | Error control coding for mobile channel, communication applications, capacity of cellular communication networks, mobile communication standards. | 10 |
| **Module 4** | Wireless data communication systems, wireless multimedia, ATM and IP, paging, wireless local loops. Mobile satellite communication, third generation cellular systems, GSM systems, universal mobile telecommunication systems. | 14 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Rappa port, "Wireless Communication" | |
| **References** | 1. William Stalling, "Wireless Communication and Networks"<br>2. D. R. Kamilo Fehar, "Wireless digital communication"<br>3. Haykin S &Moher M., "Modern wireless communication", Pearson. | |

| SET/EI/BT/C804. MAJOR PROJECT | |
|---|---|
| **Content** | **No. of Hrs.** |
| The Major Project(s) will be evaluated on the basis of the weightage of 20% of Report writing, 50% of the Project work and 30% for Presentation and Viva. There shall be two presentations for each Project evaluation and at least one outside expert will be the member of the evaluation committee for final evaluation. | 16 x 2 = 32 |

**Appendix-I**

## Mandatory Induction Program for Electrical and Instrumentation Engineering Branch

| 3 weeks duration |
| --- |
| • Physical activity<br>• Creative Arts<br>• Universal Human Values<br>• Literary<br>• Proficiency Modules<br>• Lectures by Eminent People<br>• Visits to local Areas<br>• Familiarization to Dept./Branch & Innovations |

***Induction program for students to be offered right at the start of the first year.**

### 1. Induction Program:

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

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

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

### 1.1 Physical Activity:

This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.

### 1.2 Creative Arts:

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

### 1.3 Universal Human Values:

It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program. Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

### 1.4 Literary:

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

### 1.5 Proficiency Modules:

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

### 1.6 Lectures by Eminent People:

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

### 1.7 Visits to Local Area:

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

### 1.8 Familiarization to Dept. /Branch & Innovations:

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

**Proceedings of the BoS of the Instrumentation Engineering-USIC**
(Meeting held on 26-02-2019)

6057
27/2/19

As per university notification No.: Academic/2019/358, dated 22-02-2019, the Board of Studies (BoS) meeting was held in the office of the Head, **Instrumentation Engineering**-USIC at the Chauras campus of the university. Following members were present-

1. Prof. S. C. Bhatt, Physics Dept., HNB Garhwal University -Member
2. Prof. M. M. S. Rauthan, CSE Dept., HNB Garhwal University -Member
3. Mr. Don Biswas, Asst. Professor, Instrumentation Engg.-USIC -Member
4. Prof. N.S. Panwar, Head, Instrumentation Engg.-USIC -Convener

Prof. R. P. Maheshwari, IIT Roorkee, and Dr. M. K. Panda, GBPEC, Pauri could not attend the meeting due to their pre- occupied schedule.

The following agenda were discussed, elaborated and worked out and resolved as stated.

**Agenda item No. 1.** Confirmation of the Minutes of the previous BoS meeting, held on 05-04-2018.

**Resolution:** Minutes of the BoS meeting, held on 05-04-2018 were confirmed.

**Agenda item No. 2.** Implementation of EWS as per MHRD letter F No. 19-3/2019-CU dated 19 January, 2019, and DSW letter No. HNBGU/DSW/2019 dated 04-02-2019, in the courses being run by the **Instrumentation Engineering Department**.

**Resolution:** Category- wise student strength after the EWS Reservation for the B. Tech. **Electrical and Instrumentation Engineering** course being run by the **Instrumentation Engineering Department,** is calculated as per MHRD letter F No. 19-3/2019-CU dated 19 January, 2019 and DSW letter No. HNBGU/DSW/2019 dated 04-02-2019. The following recommendations were made to enhance the seat to implement EWS.

| Category | Total Existing Intake Capacity (2018-19) | Total student strength after increased intake (to implement EWS) | |
|---|---|---|---|
| | | 2019-20 (5% EWS) | 2020-21(10% EWS) |
| SC | 04 | 05 | 06 |
| ST | 02 | 03 | 03 |
| OBC | 09 | 09 | 11 |
| Others | 16 | 16 | 16 |
| EWS | - | 02 | 04 |
| **Total** | **31** | **35** | **40** |

The meeting was concluded with the vote of thanks to the chair.

Prof. S. C. Bhatt

SR Academic Dr. 1.3.2019

Prof. M. M. S. Rauthan

Mr. Don Biswas

26.2.19
Prof. N.S. Panwar
(Convener)

Hon'ble Vice-chancellor
may kindly approve. 26.2.19

For approval
01.3.19

**Proceedings of the BoS of the Department of Instrumentation Engineering-USIC**
(Meeting held on 11-09-2019)

As per university notification No.: Academic/2019/974, dated 09-09-2019, the Board of Studies (BoS) meeting was held in the office of the Head, **Department of Instrumentation Engineering-** USIC at the Chauras campus of the university. Following members were present.

1. Prof. M. K. Panda, State Project Administrator,
   State Project Implementation Unit, Shudhowala, Dehradun. -Member
2. Prof. S. C. Bhatt, Physics Dept., HNB Garhwal University. -Member
3. Mr. Gambheer Singh Kathait, Asst. Professor,
   Dept. of Instrumentation Engg.-USIC, HNB Garhwal University. -Member
4. Prof. N. S. Panwar, Head, Dept. of Instrumentation Engg.-USIC,
   HNB Garhwal University. -Convener

Prof. R. P. Maheshwari, Dept. of Electrical Engg., IIT Roorkee and Prof. R. S. Rana Dept. of Geology, HNBGU Srinagar Garhwal could not attend the meeting due to their pre occupied schedule.

The following agenda were discussed, elaborated and worked out and resolved as stated.

**Agenda item No. 1.** Confirmation of the Minutes of the previous BoS meeting held on 05-04-2018.

**Resolution:** Minutes of the BoS meeting, held on 05-04-2018 were confirmed.

**Agenda item No. 2. Programme Outcome (POs)** of B. Tech. programme in **Electrical and Instrumentation Engineering** (EIE).

**Resolution:** To make the B. Tech. Electrical and Instrumentation Engineering programme more popular as per the concept of outcome based education and attractive to the students seeking admission in the Engineering courses, it is decided that the Programme Outcome (POs) need to be added in the B. Tech. programme in **Electrical and Instrumentation Engineering** (EIE). This new addition is also consistent with the guideline(s) recognized by the NBA, NAAC and AICTE. POs of the programme B. Tech. **Electrical and Instrumentation Engineering** (EIE) are designed accordingly **(Enclosure-1)**.

**Agenda item No. 3. Programme Specific Outcomes (PSOs)** of B. Tech. programme in **Electrical and Instrumentation Engineering** (EIE).

**Resolution:** To make the B. Tech. Electrical and Instrumentation Engineering programme more popular as per the concept of outcome based education and attractive to

the students seeking admission in the Engineering courses, it is decided that the Programme Specific Outcome (PSOs) need to be added in the B. Tech. programme in **Electrical and Instrumentation Engineering** (EIE). This new addition is also consistent with the guideline(s) recognized by the NBA, NAAC and AICTE. PSOs of the programme B. Tech. **Electrical and Instrumentation Engineering** (EIE) are designed accordingly **(Enclosure-2)**.

**Agenda item No. 4. Course Outcome (COs)** of B. Tech. course in **Electrical and Instrumentation Engineering** (EIE).

**Resolution:** To understand the basic principles of Electrical and Instrumentation Engineering course as per the concept of outcome based education, its characteristics and its utility to different fields from student point of view, it is decided that the Course Outcome (COs) need to be added in the course **Electrical and Instrumentation Engineering** (EIE). This new addition is also consistent with the guideline(s) recognized by the NBA, NAAC and AICTE. The COs of the course **Electrical and Instrumentation Engineering** (EIE) are designed accordingly **(Enclosure-3)**.

**Agenda item No. 5.** To identify the **Experts for the Selection Committee(s)** for the Department of Instrumentation Engineering-USIC.

**Resolution:** The identified experts for Selection Committee(s) for the recruitment of teachers in the Instrumentation Engineering (IE) Department and University Science Instrumentation Centre (USIC) are listed in **Enclosure-4 (Envelop-1)**.

**Agenda item No. 6.** To list the names of paper setters/ practical examiners for the examinations of the courses of the department.

**Resolution:** The names of the paper setters/ practical examiners for the examination of the courses of the department are as listed in **Enclosure-5 (Envelop-2)**.

The meeting was concluded with vote of thanks to the convener.

The item wise resolutions are being recommended for the kind consideration and approval of the School Board/Academics Council.

Prof. M. K. Panda

Mr. Gambheer Singh Kathait

Prof. S. C. Bhatt

699
16/9/19
1067

Hon'ble Vice chancellor
May kindly approve.

11.09.2019

Prof. N. S. Panwar
(Convener)

DR Academics for comments
18.9.2019

Pl. examine
24/9/19
SO (Academic)

पाठ्यक्रम समिति के उपस्थित सदस्यों द्वारा मद सं० 01 से 06 तक के निर्णय कार्यवृत्त में समाविष्ट है।

अतः अनुमोदनार्थ प्रस्तुत

27/9/19

SO (Acad)

DR (A)

27/9/2019

Pl. Specify part of all agenda, which agenda needs to be put up to S.B. and which are the agenda needs to be approved by V.C.

27/9/19
SO (Academic)
Sh Kalaiya

14/10/2019

पाठ्यक्रम समिति में उपस्थित सदस्यों द्वारा संस्तुत कार्यवृत्त को माननीय कुलपति जी के अनुमोदनार्थ प्रस्तुत।

'X'

14/10/19

विन्दु सं०- 2, 3 एवं 4 हेतु बोर्ड के सदस्यों अवर विन्दु अनुमोदनार्थ प्रेषित

SO (Acad)

14/10/2019

DR (A)

CA. may please consider and approve resolutions passed by BOS. Agenda item no. 2, 3 & 4 needs to be put up before SB by concerned convener of BOS.

'A'

Registrar

Manbleve

'X' Approved on the basis of 'A'

16/10/19

31.10.2019

**Proceedings of the BoS of the Department of Instrumentation Engineering-USIC**
(Meeting held on 10-07-2020)

As per university notification No.: Academic/2020/256, dated 10-07-2020, the Board of Studies (BoS) meeting was held online through ZOOM app. Following members attended the meeting:

1. Prof. V. M. Mishra, Head, Dept. of Electrical Engineering, GBPIET, Ghurdauri, Pauri Garhwal. -Member
2. Prof. S. C. Bhatt, Dept. of Physics, HNB Garhwal University. -Member
3. Prof. R. S. Rana, Dept. of Geology, HNB Garhwal University. -Member
4. Mr. Gambheer Singh Kathait, Asst. Professor, Dept. of Instrumentation Engg.-USIC, HNB Garhwal University. -Member
5. Prof. N. S. Panwar, Head, Dept. of Instrumentation Engg.-USIC, HNB Garhwal University. -Convener

Prof. M. K. Panda, State Project Administrator, State Project Implementation Unit, Shudhowala, Dehradun could not attend the meeting due to his pre occupied schedule.

The following agenda were discussed, elaborated and worked out and resolved as stated.

**Agenda item No. 1.** Confirmation of the Minutes of the previous BoS meeting held on 11-09-2019.

**Resolution:** Minutes of the BoS meeting, held on 11-09-2019 were confirmed.

**Agenda item No. 2.** Constitution of the Departmental Academic Integrity Panel (DAIP) as per UGC letter D.O. No. F.1-18/2010/(CPP-II) dated 06/08/2018.

**Resolution:** Following Departmental Academic Integrity Panel (DAIP) has been suggested by the committee.

1. Head, Dept. of Instrumentation Engineering — Chairman
2. One senior academician outside the department to be approved/ nominated by Hon'ble Vice-Chancellor
   (i) Prof. M. M. S. Rauthan, Dept. of CSE — Member
   (ii) Prof. H. C. Nainwal, Dept. of Geology — Member
3. One member well versed in anti- plagiarism tools nominated by Head of Department
   (i) Prof. S.C. Bhatt, Dept. of Physics — Member

251
25/7/2020

**Agenda item No. 3.** (i) Introduction of MOOC's from SWAYAM Platform in the upcoming semesters of syllabus running since 2018-19 onwards.

(ii) To design the syllabus in accordance with the AICTE/CBCS norms along with the courses running from the MOOC/SWAYAM platform, for **B. Tech. (Electrical and Instrumentation Engineering)** course for Batch 2020-21 onwards.

**Resolution:** Syllabi for **B. Tech. (Electrical and Instrumentation Engineering)** course with MOOC/SWAYAM Courses were discussed deliberately **(Enclosures- 1 and 2).**

Prof. V. M. Mishra

Prof. S. C. Bhatt

Prof. R. S. Rana

कुलसचिव कार्यालय
सं 1912
दि 22/07/2020

Mr. Gambheer Singh Kathait

10.07.2020
Prof. N. S. Panwar
(Convener)

Hon'ble Vice-chancellor
may kindly approve.
15.07.2020

पाठ्यक्रम समिति USIC की बैठक 10.7.2020 के निर्णयों हेतु विषय निर्णयों में Agenda 10.03 School Board में रखा जायेगा। शेष विषय सेमेस्टर के पाठ्यक्रम के अनुमोदन हेतु प्रस्तुत किये हैं। अतः माननीय कुलपति जी के अनुमोदन हेतु प्रेषित।

SO (Acad)

DR(A)

17/7/20

Agenda item no. 2 & 3 needs approval of school Board. Minutes of BOS are submitted for kind consideration and approval please.

Registrar

Hon'ble VC
28.7.2020

24.7.2020

17/7/20

# Curriculum and Syllabus

## Bachelor of Technology

**in**

## Electrical and Instrumentation Engineering

(Applicable for 2020-21 batch and onwards)

**Department of Instrumentation Engineering**
**School of Engineering and Technology,**
**H. N. B. Garhwal University,**
**Srinagar Garhwal, Uttarakhand- 246174**

# Curriculum

**Definitions/ Descriptions**

1. **Credit Equivalent**

| | No. of Contact Hours per Week | Equivalent Credits |
|---|---|---|
| **Lecture+ Tutorial** | **4/3** | **3** |
| **Practical** | **2** | **1** |

***Mandatory Induction Program**

| 3 weeks duration |
|---|
| • *Physical activity*<br>• *Creative Arts*<br>• *Universal Human Values*<br>• *Literary*<br>• *Proficiency Modules*<br>• *Lectures by Eminent People*<br>• *Visits to local Areas*<br>• *Familiarization to Dept./Branch & Innovations* |

***Induction program for students to be offered right at the start of the first year. Appendix –I sheet has attached for details.**

2. **Code for Courses:**

Code for a course consists of two alphabets followed by three digits and an optional alphabet.

- First three alphabets represent the school name (SET: School of Engineering and Technology).
- Next two alphabets in the code represent the subject area of the course. E.g. (SH: Applied Science and Humanities, EC: Electronics and Communication Engineering, EI: Electrical and Instrumentation Engineering, EE: Electrical Engineering, ME: Mechanical Engineering, CS: Computer Science and Engineering, IT: Information Technology, AECC: Ability Enhancement Compulsory Courses, HS: Humanities and Social Sciences including Management courses, MC: Mandatory Course).
- Then there will be subject code with 4 letters out of which first will tell the nature of subject (C: Core/E: Elective/S: Skill Enhancement/M: Mandatory Course/H: Humanities/A: Applied Science) and next three letters will tell the number according to the semester(for example 801 will tell its 8$^{th}$ semester subject). First digit represents the semester. Next two digits represent the sequence number of course in the list of courses of a semester. Last word in few courses is MOOC, which represents that course may be opted from SWAYAM Portal.

**Elective Course:**
Elective courses are provided in V, VI, VII and VIII semesters to provide student with flexibility to choose courses of their interest from a list of offered electives. These Electives are the courses offered by the same department or other departments for the students.

**MOOC Courses:**
"MOOCs" means Massive Open Online Courses (MOOCs) are such online courses which are developed and made available on the SWAYAM platform of Government of India. MOOCs guidelines on online learning issued by the MHRD vide orders dated 11$^{th}$ March 2016 and subsequent addendums issued by the MHRD.
Any candidate can be permitted to opt for only up to 20% of the total courses being offered in a particular program in a semester through the online learning courses provided through SWAYAM platform.

## Semester-wise list of subjects

### Semester I

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C101 | Mathematics I | 3 | 1 | - | 4 | 3 |
| 2 | SET/SH/BT/C102 | Physics | | | | | |
| | SET/SH/BT/C203 | Chemistry | | | | | |
| 3 | SET/EE/BT/C103 | Basic Electrical Engineering | 3 | 1 | - | 4 | 3 |
| | SET/EE/BT/C103 MOOC | Fundamentals of Electrical Engineering* | - | - | - | | |
| | SET/ME/BT/C202 | Basic Mechanical Engineering | 3 | 1 | - | 4 | 3 |
| 4 | SET/EC/BT/C104 | Basic Electronics | 3 | 1 | - | 4 | 3 |
| | SET/ME/BT/C204 | Engineering Mechanics | | | | | |
| 5 | SET/IT/BT/C105 | Fundamentals of Information Technology | 3 | 1 | - | 4 | 3 |
| | SET/CS/BT/C205 | Computer Programming | | | | | |
| 6 | AECC106 | **Environmental Science | 2 | - | - | 2 | 2 |
| 7 | SET/SH/BT/C106 | Physics Lab | - | - | 2 | 2 | 1 |
| | SET/SH/BT/C207 | Chemistry Lab | | | | | |
| 8 | SET/EE/BT/C107 | Basic Electrical Engineering Lab | - | - | 2 | 2 | 1 |
| | SET/ME/BT/C206 | Basic Mechanical Engineering Lab | | | | | |
| 9 | SET/IT/BT/C108 | Information Technology Lab | - | - | 2 | 2 | 1 |
| | SET/CS/BT/C208 | Computer Programming Lab | | | | | |
| 10 | SET/ME/BT/S109 | ***Engineering Graphics | - | - | 4 | 4 | 2 |
| **Total** | | | 17 | 5 | 10 | 32 | 22 |

*MOOC Course, ** Ability Enhancement Compulsory course.

**Induction program for students to be offered right at the start of the first year.

***Skill Enhancement Course.

### Semester II

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C201 | Mathematics II | 3 | 1 | - | 4 | 3 |
| 2 | SET/ME/BT/C202 | Basic Mechanical Engineering | 3 | 1 | - | 4 | 3 |
| | SET/EE/BT/C103 | Basic Electrical Engineering | | | | | |
| 3 | SET/SH/BT/C203 | Chemistry | 3 | 1 | - | 4 | 3 |
| | SET/SH/BT/C102 | Physics | | | | | |
| 4 | SET/ME/BT/C204 | Engineering Mechanics | 3 | 1 | - | 4 | 3 |
| | SET/EC/BT/C104 | Basic Electronics | | | | | |
| 5 | SET/CS/BT/C205 | Computer Programming | 3 | 1 | - | 4 | 3 |
| | SET/IT/BT/C105 | Fundamentals of Information Technology | | | | | |
| 6 | AECC206 | *General English | 2 | - | - | 2 | 2 |
| 7 | SET/ME/BT/C206 | Basic Mechanical Engineering Lab | - | - | 2 | 2 | 1 |
| | SET/EE/BT/C107 | Basic Electrical Engineering Lab | | | | | |
| 8 | SET/SH/BT/C207 | Chemistry Lab | - | - | 2 | 2 | 1 |
| | SET/SH/BT/C106 | Physics Lab | | | | | |
| 9 | SET/CS/BT/C208 | Computer Programming Lab | - | - | 2 | 2 | 1 |
| | SET/IT/BT/C108 | Information Technology Lab | | | | | |
| 10 | SET/ME/BT/S209 | **Engineering Workshop | - | - | 4 | 4 | 2 |
| **Total** | | | 17 | 5 | 10 | 32 | 22 |

* Ability Enhancement Compulsory course.

**Skill Enhancement Course.

## Semester III

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C301 | Mathematics III | 3 | 1 | - | 4 | 3 |
| 2 | SET/EC/BT/C302 | Electronic Devices and Circuits | 3 | 1 | - | 4 | 3 |
| 3 | SET/EC/BT/C303 | Digital Electronics | 3 | 1 | - | 4 | 3 |
| | SET/EC/BT/C303MOOC | Switching Circuits and Logic Design* | - | - | - | | |
| 4 | SET/EI/BT/C304 | Electrical Machines | 3 | 1 | - | 4 | 3 |
| 5 | SET/EC/BT/C305 | Electromagnetic Field Theory | 3 | 1 | - | 4 | 3 |
| | SET/EC/BT/C305MOOC | Applied Electromagnetics for Engineers* | - | - | - | | |
| 6 | SET/EI/BT/C306 | Electrical Measurements and Instrumentation | 3 | 1 | - | 4 | 3 |
| 7 | SET/EC/BT/C307 | Digital Electronics Lab | - | - | 2 | 2 | 1 |
| 8 | SET/EI/BT/C308 | Electrical Measurements and Instrumentation Lab | - | - | 2 | 2 | 1 |
| 9 | SET/EC/BT/C309 | Electronic Devices and Circuits Lab | - | - | 2 | 2 | 1 |
| 10 | SET/EI/BT/C310 | Electrical Machines Lab | - | - | 2 | 2 | 1 |
| 11 | SET/MC/BT/M311 | Indian Constitution (**MC) | - | - | - | Self study | Qualifying |
| **Total** | | | 18 | 6 | 8 | 32 | 22 |

*MOOC Course, **Mandatory Course.

## Semester IV

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C401 | Sensors and Transducers | 3 | 1 | - | 4 | 3 |
| 2 | SET/EC/BT/C402 | Analog Integrated Circuits | 3 | 1 | - | 4 | 3 |
| 3 | SET/EI/BT/C403 | Microprocessors and Interfacing | 3 | 1 | - | 4 | 3 |
| 4 | SET/EI/BT/C404 | Analytical Instruments | 3 | 1 | - | 4 | 3 |
| 5 | SET/EI/BT/C405 | Signals and Systems | 3 | 1 | - | 4 | 3 |
| | SET/EI/BT/C405MOOC | Principles of Signals and Systems* | - | - | - | | |
| 6 | SET/EI/BT/C406 | Circuit Theory | 3 | 1 | - | 4 | 3 |
| | SET/EI/BT/C406MOOC | Network Analysis* | - | - | - | | |
| 7 | SET/EI/BT/C407 | Sensors and Transducers Lab | - | - | 2 | 2 | 1 |
| 8 | SET/EI/BT/C408 | Microprocessors and Interfacing Lab | - | - | 2 | 2 | 1 |
| 9 | SET/EI/BT/C409 | Analytical Instruments Lab | - | - | 2 | 2 | 1 |
| 10 | SET/EI/BT/C410 | Signals and Networks Lab | - | - | 2 | 2 | 1 |
| 11 | SET/MC/BT/M411 | Essence of Indian Traditional Knowledge (**MC) | - | - | - | Self study | Qualifying |
| **Total** | | | 18 | 6 | 8 | 32 | 22 |

* MOOC Course, **Mandatory Course.

## Semester V

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C501 | Power Systems | 3 | 1 | - | 4 | 3 |
| | SET/EI/BT/C501 MOOC | Power System Analysis* | - | - | - | | |
| 2 | SET/EI/BT/C502 | Control Systems | 3 | 1 | - | 4 | 3 |
| | SET/EI/BT/C502 MOOC | Control Systems* | - | - | - | | |
| 3 | SET/EI/BT/C503 | Industrial Instrumentation | 3 | 1 | - | 4 | 3 |
| 4 | SET/EI/BT/C504 | Power Electronics | 3 | 1 | - | 4 | 3 |
| | SET/EI/BT/C504 MOOC | Power Electronics* | - | - | - | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | | PE-01 | 3 | 1 | - | 4 | 3 |
| 6 | SET/EI/BT/C506 | Power Systems Lab | - | - | 2 | 2 | 1 |
| 7 | SET/EI/BT/C507 | Control Systems Lab | - | - | 2 | 2 | 1 |
| 8 | SET/EI/BT/C508 | Industrial Instrumentation Lab | - | - | 2 | 2 | 1 |
| 9 | SET/EI/BT/C509 | Power Electronics Lab | - | - | 2 | 2 | 1 |
| 10 | SET/HS/BT/H510 | Foundations of Yoga (**HSMC) | 3 | 1 | - | 4 | 3 |
| **Total** | | | 18 | 7 | 8 | 32 | 22 |

*MOOC Course, ** Humanities and Social Sciences including Management courses.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 01 (PE-01)** | 1 | SET/EI/BT/E505 (i) | Electrical Drives |
| | 2 | SET/EI/BT/E505 (ii) | Line Commutated and Active PWM Rectifiers |
| | 3 | SET/EI/BT/E505 (iii) | Electrical Machine Design |

**Semester VI**

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/EC/BT/C601 | Digital Signal Processing | 3 | 1 | - | 4 | 3 |
| 2 | SET/EI/BT/C602 | PLC and Automation | 3 | 1 | - | 4 | 3 |
| 3 | SET/EI/BT/C603 | Process Control | 3 | 1 | - | 4 | 3 |
| 4 | | PE-02 | 3 | 1 | - | 4 | 3 |
| 5 | | OE-01 | 3 | 1 | - | 4 | 3 |
| 6 | SET/EI/BT/C606 | PLC and Automation Lab | - | - | 2 | 2 | 1 |
| 7 | SET/EI/BT/C607 | Process Control Lab | - | - | 2 | 2 | 1 |
| 8 | SET/EI/BT/C608 | Seminar | - | - | - | 4 | 1 |
| 9 | SET/SH/BT/A609 | Biology * | 3 | 1 | - | 4 | 3 |
| **Total** | | | 18 | 6 | 4 | 32 | 21 |

* Applied Science and Humanities.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 02 (PE-02)** | 1 | SET/EI/BT/E604 (i) | HVDC Transmission Systems |
| | 2 | SET/EI/BT/E604 (ii) | Electrical machines-II |
| | | SET/EI/BT/E604 (ii)MOOC | Electrical machines-II** |
| | 3 | SET/EI/BT/E604 (iii) | Embedded Systems |
| | | SET/EI/BT/E604 (iii)MOOC | Embedded Systems** |

**MOOC Course

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Open Elective 01 (OE-01)** | 1 | SET/EI/BT/E605 (i) | Power Plant Engineering |
| | 2 | SET/EI/BT/E605 (ii) | Optical Instrumentation |
| | 3 | SET/EI/BT/E605 (iii) | Principles of Communication Systems |

**Semester VII**

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C701 | Biomedical Instrumentation | 3 | 1 | - | 4 | 3 |
| 2 | SET/EI/BT/C702 | Vacuum Instrumentation and Thin Film Deposition Techniques | 3 | 1 | - | 4 | 3 |
| 3 | | PE-03 | 3 | 1 | - | 4 | 3 |
| 4 | | OE-02 | 3 | 1 | - | 4 | 3 |
| 5 | SET/EI/BT/C705 | Biomedical Instrumentation Lab | - | - | 2 | 2 | 1 |
| 6 | SET/EI/BT/C706 | Vacuum Instrumentation and Thin Film Deposition Techniques Lab | - | - | 2 | 2 | 1 |
| 7 | SET/EI/BT/C707 | Project Preparation | - | - | 6 | 6 | 3 |
| 8 | SET/EI/BT/C708 | Industrial Training Seminar | - | - | - | - | 2 |
| 9 | SET/HS/BT/H709 | Principles of Management (*HSMC) | 3 | 1 | - | 4 | 3 |
| **Total** | | | 18 | 6 | 6 | 30 | 22 |

* Humanities and Social Sciences including Management courses.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 03 (PE-03)** | 1 | SET/EI/BT/E703 (i) | Electrical Energy Conservation & Auditing |
| | 2 | SET/EI/BT/E703 (ii) | Power System Protection |
| | | SET/EI/BT/E703 (ii)MOOC | Power System Protection** |
| | 3 | SET/EI/BT/E703 (iii) | Control Systems II |
| | 4 | SET/EI/BT/E703 (iv) | Solar Energy Engineering & Technology |
| | 4 | SET/EI/BT/E703 (iv)MOOC | Solar Energy Engineering & Technology** |

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Open Elective 02 (OE-02)** | 1 | SET/EI/BT/E704 (i) | Industrial Drives and Control |
| | 2 | SET/EI/BT/E704 (ii) | Introduction to Robotics |
| | | SET/EI/BT/E704 (ii)MOOC | Introduction to Robotics ** |
| | 3 | SET/EI/BT/E704 (iii) | Computer Architecture |
| | | SET/EI/BT/E704 (iii)MOOC | Computer Architecture and Organization** |

**MOOC Course

## Semester VIII

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | | PE-04 | 3 | 1 | - | 4 | 3 |
| 2 | | OE-03 | 3 | 1 | - | 4 | 3 |
| 3 | | OE-04 | 3 | 1 | - | 4 | 3 |
| 4 | SET/EI/BT/C803 | Major Project | - | - | 16 | 16 | 8 |
| **Total** | | | 9 | 3 | 16 | 28 | 17 |

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 04 (PE-04)** | 1 | SET/EI/BT/E801 (i) | Renewable Energy Engineering |
| | | SET/EI/BT/E801 (i)MOOC | Non-conventional Energy Resources* |
| | 2 | SET/EI/BT/E801 (ii) | Electrical Distribution System |
| | 3 | SET/EI/BT/E801 (iii) | Control Systems Design |
| | 4 | SET/EI/BT/E801 (iv) | Switchgear and Protection |

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Open Elective 03 and 04 (OE-03, OE-04)** | 1 | SET/EI/BT/E802 (i) | Data Communication and Networking |
| | 2 | SET/EI/BT/E802 (ii) | Fuzzy Logic & Neural Network |
| | | SET/EI/BT/E802 (ii)MOOC | Fuzzy Sets, Logic And Systems & Applications * |
| | 3 | SET/EI/BT/E802 (iii) | Virtual Instrumentation |
| | 4 | SET/EI/BT/E802 (iv) | Mobile Communication and Networks |

*MOOC Course

**Note**

(1) Topic for the Seminar in 6th semesters shall be chosen by students in consultation with faculty. Topic shall not be mentioned in the syllabus anywhere, however, it should be related to Electrical and Instrumentation Engineering.
(2) Students shall choose 2 professional & 2 open elective subjects in 7th Semester and 1 professional & 2 open elective subjects in 8th semester, each from the given Table. An elective subject shall be offered only when at least 30% of the intake opt for that subject.
(3) Desirous students opting for an online course would be required to register for the MOOCs for that course/paper through SWAYAM-NPTEL Local Chapter and it will be mandatory for her/him to share necessary information with the college /institute.
(4) Major Project work shall be carried out during the 7th and 8th semester. Students can undertake Major Project individually or in group of not more than Four students, under the guidance of a faculty or a group of faculty. Students have to present Synopsis of Major Project during the 7th semester. Feasibility of the Project shall be assessed by the project evaluation committee of the department before the end of 7th semester. However, Major Project would be evaluated in the end of 8th semester.

**Detailed Syllabi**

**SEMESTER I**

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C101 | Mathematics I | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/SH/BT/C102 | Physics | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/SH/BT/C203 | Chemistry | | | | | | | | | |
| 3 | SET/EE/BT/C103 | Basic Electrical Engineering | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EE/BT/C103 MOOC | Fundamentals of Electrical Engineering* | - | - | - | - | - | - | | | |
| | SET/ME/BT/C202 | Basic Mechanical Engineering | 3 | 1 | - | 10 | 20 | 30 | 70 | | |
| 4 | SET/EC/BT/C104 | Basic Electronics | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/ME/BT/C204 | Engineering Mechanics | | | | | | | | | |
| 5 | SET/IT/BT/C105 | Fundamentals of Information Technology | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/CS/BT/C205 | Computer Programming | | | | | | | | | |
| 6 | AECC106 | **Environmental Science | 2 | - | - | 10 | 20 | 30 | 70 | 100 | 2 |
| 7 | SET/SH/BT/C106 | Physics Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/SH/BT/C207 | Chemistry Lab | | | | | | | | | |
| 8 | SET/EE/BT/C107 | Basic Electrical Engineering Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/ME/BT/C206 | Basic Mechanical Engineering Lab | | | | | | | | | |
| 9 | SET/IT/BT/C108 | Information Technology Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/CS/BT/C208 | Computer Programming Lab | | | | | | | | | |
| 10 | SET/ME/BT/S109 | ***Engineering Graphics | | | 4 | 30 | - | 30 | 70 | 100 | 2 |
| | | | | | | | | | | **Total** | 22 |

*MOOC Course, ** Ability Enhancement Compulsory course.
***Skill Enhancement Course.

L - Lecture hours, T - Tutorial hours, P - Practical hours, T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

**Induction program** for students to be offered right at the start of the first year. For **Induction Program** please refer **Appendix-I** for guidelines.

| **SET/SH/BT/C101. MATHEMATICS I** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Vector Calculus** | Interpretation of Vectors & Scalars, Gradient, Divergence and Curl of a Vector and Their Physical Interpretation, Gauss Divergence Theorem and Stoke's Theorem. | 9 |
| **Matrices** | Elementary Row and Column Transformation, Linear Dependence, Rank of Matrix, Consistency of System of Linear Equation and Solution of Linear System of Equations. Characteristic Equation, Cayley-Hamilton Theorem, Eigen Values and Eigen Vectors, Diagonalization, Complex Matrices. | 13 |
| **Differential Calculus** | Libnitz theorem, Partial Differentiation, Euler's Theorem, Asymptotes, Curve Tracing, Envelops and Evolutes. Change of Variables, Jacobians, Expansion of Functions of One and Several Variables. Cylindrical and Spherical Coordinate System. Approximation of Errors. Extrema of Function of Several Variables, Langrange's Method. | 13 |
| **Probability and Statistics** | Binomial Distribution, Normal Distribution and Poisson's Distribution. Correlation and Regression. | 9 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers.<br>2. H K Das, "Advanced Engineering Mathematics", S Chand.<br>3. Erwin Kreyszig, "Advanced Engineering Mathematics". | |
| **References** | 1. Shanti Narayan, "A Text Book of Matrices", S. Chand .<br>2. Finney Thomas, "Calculus and Analytical Geometry", Narosa Publication House.<br>3. N. Piskunov, "Differential and Integral Calculus". | |

| **SET/SH/BT/C102. PHYSICS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Optics** | Interference: Coherent Sources, Conditions of Interference, Fresnel's Biprism Experiment, Interference in Thin Films, Newton's Rings; Single and n-Slit Diffraction, Diffraction Grating, Raleigh's Criterion of Resolution, Resolving Power of Telescope, microscope; Phenomenon of Double Refraction, Ordinary and Extra-ordinary Rays, Nicol Prism, Circularly and Elliptically Polarized Light, Fresnel Theory, Optical Activity, Specific Rotation. | 13 |

| | | |
|---|---|---|
| **Lasers and X-Rays** | Laser: Principle of Laser Action, Einstein's Coefficients, Construction and Working of He-Ne and CO2 laser; Diffraction of X-Rays, Bragg's Law, Practical Applications of X-Rays, Compton Effect. | 8 |
| **Basics Material Science** | Introduction to crystal structure of materials, Miller indices for crystallographic planes and directions. X-ray diffraction for determination of crystal structure. Defects in solids: point, line and planar defects and their effect on properties of materials. Band theory of solids, conductors, semi-conductors and insulators, metals. Fermi Level. Magnetism: dipole moments, paramagnetism, Curie's law, magnetization and hysterisis, Ferromagnetism and Anti-Ferromagnetism. Ferroelectricity and Piezoelectricity. Superconductivity in materials. | 14 |
| **Electromagnetism** | Ampere's Law and Displacement Current, Maxwell's Equations in Integral and Differential Forms, Electromagnetic Wave Propagation in Free Space and Conducting Media, Poynting Theorem. | 8 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. Gaur, Gupta, "Engineering Physics"<br>2. Callister W.D., "Materials Science and Engineering: An introduction", 6th Edition, John Wiley & Sons Inc., New York 2002 | |
| **References** | 1. J. R. Taylor, C.D. Zafiratos and M. A. Dubson, Modern Physics for Scientists and Engineers, , 2nd Ed.,Pearson (2007)<br>2. Arthur Beiser, Concepts of Modern Physics, 6th Ed., TMH, (2009)<br>3. A.K. Ghatak : Optics<br>4. Subramanyam, Brijlal : Optics<br>5. Wehr Richords & Adiav : Physics of Atoms<br>6. O.Svelto : Lasers<br>7. D.J. Griffith : Electrodynamics<br>8. Robert Eisberg and Robert Resnick, Quantum Physics of atoms, Molecules, Solids, Nuclei and Particle, 2nd Ed., John Wiley(2006)<br>9. Raghavan V. " Materials Science and Engineering – A first course" 5th Edition, Prentice Hall, New Delhi, 1998<br>10. Van Vlack, LH, " Elements of Materials Science and Engineering". 6th Edition, Addison – Wesley Singapore, 1989 | |

| **SET/EE/BT/C103. BASIC ELECTRICAL ENGINEERING** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **DC Networks** | Concepts of linear, nonlinear, active, passive, unilateral and bilateral elements; Ideal and practical voltage & current sources – conversion from one from the other; Kirchhoff's laws – statements; Mesh Analysis; Nodal Analysis; Delta-Star & Star-Delta conversion; Superposition principle; Thevenin's theorem – statement, advantages in case of complex networks; explanation & illustration with examples; Norton's theorem, Maximum power transfer theorem, Reciprocity Theorem and its application. | 10 |
| **Single Phase AC Circuits** | Generation of single phase a.c. voltage and determination of average (mean) and RMS (effective) values of voltage and current with special reference to sinusoidal waveforms; Form factor and peak factor for various waves; Representation of sinusoidal time varying quantities as phasors; concepts of reactance, impedance and their representation in complex forms using j operator; Steady state analysis of series R-L-C circuit & its phasor diagram; Concept of power & power factor; Concept of admittance, susceptance in parallel circuits; Analysis of series parallel circuits & phasor diagrams; Resonance in series and parallel circuits. | 10 |
| **Filter Circuits** | Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter. | 4 |
| **Three Phase Circuits** | Generation of 3-phase balanced sinusoidal voltage; star & delta connections; line & phase quantities (current & voltage); Solution of 3-phase star/delta circuits with balanced supply voltage and balanced load; phasor diagram; 3-phase, 4-wire circuits; Measurement of three phase power by two wattmeter method; phasor diagram with balanced load and determination of load power factor from wattmeter readings. | 6 |
| **Transformers and Rotating Machines** | Transformers: Constructional features and principle of operation, concept of ideal transformer under no load & loaded conditions and its equivalent circuit; Practical transformer rating & its equivalent circuit; Autotransformer – principle of operation & relative advantages & disadvantages; Rotating Machine: construction features (stator, rotor & air gap), conditions for production of steady electromagnetic torque; Three phase Induction motor: constructional features and operation; DC Machines: construction features, EMF and Torque expression, Classification of D.C. motors and generators; Stepper motor. | 8 |
| **Measuring Instruments** | DC PMMC instruments – constructional feature and principle of operation; Moving iron meters – construction and principle of operation; Dynamometer type wattmeter; Induction type energy meter construction & principle of operation. | 6 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. I.J. Nagrath, "Basic Electrical Engineering," Tata Mc. Graw Hill. | |
| **References** | 1. A. E. Fitgerald, D.E., Higginbotham and A Grabel, "Basic Electrical Engineering", Mc Graw Hill.<br>2. Rizzoni, Principles and Applications of Electrical Engineering, TMH.<br>3. V. Del Toro. "Principles of electrical Engineering, "Prentice hall.<br>4. W.H. Hayt & J.E. Kemmerly," Engineering circuit Analysis, "Mc Graw Hill.<br>5. H. Cotton, "Advanced Electrical Technology" Wheeler Publishing. | |

| SET/EE/BT/C103MOOC. FUNDAMENTAL OF ELECTRICAL ENGINEERING | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Basic Concepts and Basic Laws, Methods of Analysis, DC Network Theorems | 10 |
| **Week 4-6** | Capacitors and Inductors and First Order Circuits, Sinusoidal and Phasors, Sinusoidal Steady-State Analysis | 10 |
| **Week 7-9** | AC Circuit Analysis and Network Theorems, Series and Parallel Resonance and Magnetically Coupled Circuits. Three Phase Circuits and Power Measurements | 10 |
| **Week 10-12** | Single Phase Transformers, Three Phase Induction Machines, DC Machines. | 10 |
| | **Total No. of Hours** | **40** |
| **Textbooks** | 2. I.J. Nagrath, "Basic Electrical Engineering," Tata Mc. Graw Hill. | |
| **References** | 6. A. E. Fitgerald, D.E., Higginbotham and A Grabel, "Basic Electrical Engineering", Mc Graw Hill.<br>7. Rizzoni, Principles and Applications of Electrical Engineering, TMH.<br>8. V. Del Toro. "Principles of electrical Engineering, "Prentice hall.<br>9. W.H. Hayt & J.E. Kemmerly," Engineering circuit Analysis, "Mc Graw Hill.<br>10. H. Cotton, "Advanced Electrical Technology" Wheeler Publishing. | |

| SET/EC/BT/C104. BASIC ELECTRONICS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Semiconductor Diodes** | Semiconductor materials- intrinsic and extrinsic types, Ideal Diode as switch, Terminal characteristics of PN diode - p-n junction under open circuit condition, p-n junction under forward bias and reverse bias conditions, p-n junction in breakdown region; Zener diode and applications e.g. voltage regulator; Rectifier Circuits, Clipping and Clamping circuits; LED, Photo Diode. | 10 |
| **Bipolar Junction Transistors** | Physical structure, physical operation and current-voltage characteristics of NPN transistor; Use of Voltage dependent Current source as an Voltage amplifier; Transistor as an amplifier: Characteristics of CE amplifier; Active region operation of transistor; D.C. analysis of Common Emitter Amplifier: load line analysis; Transistor as a switch: cut-off and saturation modes. | 10 |
| **Field Effect Transistor** | Enhancement-type MOSFET: structure and physical operation, current-voltage characteristics; MOSFET as a Switch, MOSFET as a Voltage dependent Current source and Amplifier. | 8 |
| **Operation Amplifier** | Ideal Op-amp; Properties of the ideal Operational Amplifier; op-amp application circuits (assuming ideal op amp): inverting amplifier, non -inverting amplifier, weighted summer, integrator, and differentiator. | 8 |
| **Digital Logic and Gates** | Binary, octal and hexadecimal number systems; Methods of base conversions; Binary, octal and hexadecimal arithmetic; Representation of signed numbers; Basic logic operations and logic gates; MOSFET Switch Implementation of Logic Gates e.g. Inverter, NAND, NOR. Basic postulates and fundamental theorems of Boolean algebra. | 8 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Agarwal, Anant; Lang, Jeffrey H, "Foundations of Analog and Digital Electronic Circuits", Elsevier Science & Technology Books. | |
| **References** | 1. V. Del Toro, Principles of Electrical Engineering, PHI.<br>2. Rizzoni, Principles and Applications of Electrical Engineering, TMH.<br>3. Malvino, Electronic Principles.<br>4. R.L.Boylestad & L.Nashelsky, Electronics Devices & Circuit Theory, PHI. | |

| SET/IT/BT/C105. FUNDAMENTALS OF INFORMATION TECHNOLOGY | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Definition of Electronic Computer, History, Generations, Characteristic and Application of Computers, Classification of Computers, Computer Hardware and Basic Computer Organization: CPU- ALU, CU; RAM/ROM, Various I/O devices, Peripherals, Storage Media. | 6 |
| **Computer Languages** | Binary, Hexadecimal Number System; Basic Binary Logic Operations; Binary Addition and Subtraction; Generation of Languages, Assembly Language, High level language; Translators, Interpreters, Compilers, Compilers; Flow Charts, Dataflow Diagram, Pseudo codes; Assemblers, Introduction to 4GLs. | 6 |
| **OS & Office** | Software- System and Application Software; Elementary Concepts in Operating System; Textual Vs GUI Interface, Introduction to DOS, MS Windows. | 6 |
| **Computer Networks** | Elements of Communication system; Brief Introduction to Computer Networks- Introduction of LAN and WAN. Network Topologies, Client-server Architecture. | 6 |
| **Internet** | Internet & World Wide Web, Hypertext Markup Language, DHTML, WWW, Gopher, FTP, Telnet, Web Browsers, Net Surfing, Search Engines, Email; Introduction to Web Development, Static and Dynamic Pages. | 6 |
| **IT Application and** | Basic Awareness of NICNET and ERNET; E Commerce, E governance; Brief Introduction to | 6 |

| | | |
|---|---|---|
| **Multi media** | Different Formats of Image, Audio, Video. | |
| **Information Concepts & Processing** | Definitions of Information , Need of information, quality of information, value of information, concept of information, Entropy category and Level of information in Business Organization, Data Concepts and Data Processing, Data Representation, Application of IT to E-commerce, Electronic Governance, Multimedia, Entertainment, Introduction to Information System. | 8 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Sinha, Sinha, "Computer Fundamentals".<br>2. Yadav R. P., "Information Technology". | |
| **References** | 1. D S Yadav, "Foundations of IT", New Age, Delhi.<br>2. Rajaraman, "Introduction to Computers", PHI.<br>3. Peter Nortans "Introduction to Computers", TMH.<br>4. Patterson D.A. & Hennessy J.L., "Computer Organization and Design", Morgan Kaufmann Publishers. | |

| **AECC106. ENVIRONMENTAL SCIENCE** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to Environmental Sciences** | Multidisciplinary nature of Environmental Sciences;<br>Scope and importance; Concept of sustainability and sustainable development. | 2 |
| **Ecosystems** | What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :<br>a. Forest ecosystem<br>b. Grassland ecosystem<br>c. Desert ecosystem<br>d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) | 6 |
| **Natural Resources: Renewable and Non-renewable Resources** | Land resources and land use change; Land degradation, soil erosion and desertification.<br>Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.<br>Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).<br>Energy resources: Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies. | 8 |
| **Biodiversity and Conservation** | Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots<br>India as a mega-biodiversity nation; Endangered and endemic species of India<br>Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.<br>Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. | 8 |
| **Environmental Pollution** | Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution<br>Nuclear hazards and human health risks<br>Solid waste management: Control measures of urban and industrial waste.<br>Pollution case studies. | 8 |
| **Environmental Policies & Practices** | Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture<br>Environment Laws: Environment Protection Act 1986; Air (Prevention & Control of Pollution) Act 1981; Water (Prevention and control of Pollution) Act 1974; Wildlife Protection Act 1972; Forest Conservation Act 1980. International agreements: Montreal protocol, Kyoto protocol and Convention on Biological Diversity (CBD).<br>Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context. | 7 |
| **Human Communities and the Environment** | Human population growth: Impacts on environment, human health and welfare.<br>Resettlement and rehabilitation of project affected persons; case studies.<br>Disaster management: floods, earthquake, cyclones and landslides.<br>Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.<br>Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.<br>Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). | 6 |
| **Field work** | Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.<br>Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.<br>Study of common plants, insects, birds and basic principles of identification.<br>Study of simple ecosystems-pond, river, lake, forest patch, grassland, Delhi Ridge, etc. | 5 |
| | **Total No. of Hours** | **50** |

Suggested Readings:
1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36-37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp. 29-64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. *Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. *Tripathi 1992*.
14. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.
17. Thapar, V. 1998. *Land of the Tiger*: *A Natural History of the Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E. O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton.
20. World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University press

| **SET/SH/BT/C106. PHYSICS LAB** | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. To determine the wavelength of monochromatic light by Newton's ring method.<br>2. To determine the wavelength of monochromatic light by Fresnel's biprism.<br>3. To determine the focal length of two lenses by nodal slide and locate the position of cardinal points.<br>4. To determine the wavelength of spectral lines using plane transmission grating.<br>5. To deter mine the height of a tower with the help of a sextant. | 6x2 |
| 6. To determine the resistance of a suspended type moving coil galvanometer by Kelvin's method using a Post office box.<br>7. To determine the internal resistance of a Leclanch cell by Man's method using a Post Office Box.<br>8. To convert a Weston galvanometer into an ammeter of a given range.<br>9. To convert a Weston galvanometer into a voltmeter of a given range.<br>10. To determine the resistance per unit length of a Carey Foster's bridge wire and to determine the specific resistance of given wire. | 4x2 |
| 11. To draw hysteresis curve of a given sample of ferromagnetic material and from this to determine magnetic susceptibility.<br>12. To study the Hall Effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material.<br>13. To determine the energy band gap of a given semiconductor material. | 4x2 |
| **Total No. of Hours** | **28** |

| **SET/EE/BT/C107. BASIC ELECTRICAL ENGINEERING LAB** | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Study of analog voltmeter, ammeter, digital multimeter and CRO.<br>2. Verification of KCL and KVL.<br>3. Verification of Thevenin, Norton Network theorems.<br>4. Verification of Superposition Network theorem.<br>5. Verification of MPT Network theorem.<br>6. Verification of KCL and KVL.<br>7. Verification of Thevenin, Norton Network theorems.<br>8. Verification of Superposition Network theorem.<br>9. Verification of MPT Network theorem.<br>10. Measurement of efficiency of a single phase transformer by load test.<br>11. Determination of parameters and losses in single phase transformer by OC and SC test.<br>12. Measurement of power in a three phase circuit by two wattmeter method.<br>13. Verification of Single Phase Energy Meter constant.<br>14. Study of thee phase induction motor.<br>15. Verification of junction diode, zener diode characteristics.<br>16. Verification of Clipping and clamping circuits.<br>17. Verification of H.W. and F.W. rectifier circuit: with and without filter circuit and to determine the ripple factor.<br>18. Verification of CE characteristics of BJT. | 15x2 |
| **Total No. of Hours** | **30** |

| SET/IT/BT/C108. INFORMATION TECHNOLOGY LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Creation of a Word Document.<br>2. Creation of a Document in spreadsheet and using Formulae.<br>3. Use of Search Engine and World Wide Web.<br>4. Creation of email id and email.<br>5. Use of FTP service.<br>6. Creation of Static Web Pages using HTML.<br>7. Creation of Page Using Java Script.<br>(Besides these additional experiments can be included to give hands on experience to students. Students can be provided opportunity to work on any Information System to give them better understanding of Information System) | 14x2 |
| **Total No. of Hours** | **28** |

| SET/ME/BT/S109. ENGINEERING GRAPHICS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to Engineering Graphics** | Drawing instruments and their use – Different types of lines - Lettering & dimensioning – Familiarization with current Indian Standard Code of Practice for Engineering Drawing. Scales, Plain scales, Diagonal scales, Vernier scales. Introduction to orthographic projections- Horizontal, vertical and profile planes – First angle and third angle projections – Projection of points in different coordinates – Projections of lines inclined to one of the reference planes. | 12 |
| **Projections of lines and planes** | Projections of lines inclined to both the planes – True lengths of the lines and their angles of inclination with the reference planes – Traces of lines. Projection of plane lamina of geometric shapes inclined to one of the reference planes – inclined to both the planes, Traces of planes. Projections on auxiliary planes. | 12 |
| **Projections of polyhedral and solids** | Projections of polyhedral and solids of revolution, projection of solids with axis parallel to one of the planes and parallel or perpendicular to the other plane – Projections with the axis inclined to one of the planes. Projections of Solids with axis inclined to both the planes – Projections of spheres and combination of solids. | 12 |
| **Sections of solids** | Sections of solids by planes perpendicular to at least one of the reference planes – True shapes of sections. Developments, development of the lateral surface of regular solids like, prisms, pyramids, cylinders, cones and spheres, development of truncated solids Isometric projection – Isometric scale – Isometric views – Isometric projection of prisms, pyramids, cylinders, cones, spheres and solids made by combination of the above. | 12 |
| | **Total No. of Hours** | **48** |
| **Textbooks** | 1. Bhatt N. D, Elementary Engineering Drawing, Charotar Publishing House, Anand, 2002. | |
| **References** | 1. Narayana K L & Kannaiah P, Engineering Graphics, Tata McGraw Hill, New Delhi, 1992.<br>2. Luzadder W J, Fundamentals of Engineering Drawing, Prentice Hall of India, New Delhi, 2001.<br>3. Thomas E French & Charkes J V, Engineering Drawing & Graphing Technology, McGraw Hill Book Co, New York, 1993.<br>4. Venugopal K, Engineering Drawing & Graphics, New Age International Pvt. Ltd., New Delhi, 1994. | |

## SEMESTER II

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE. | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C201 | Mathematics II | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/ME/BT/C202 | Basic Mechanical Engineering | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EE/BT/C103 | Basic Electrical Engineering | | | | | | | | | |
| 3 | SET/SH/BT/C203 | Chemistry | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/SH/BT/C102 | Physics | | | | | | | | | |
| 4 | SET/ME/BT/C204 | Engineering Mechanics | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EC/BT/C104 | Basic Electronics | | | | | | | | | |
| 5 | SET/CS/BT/C205 | Computer Programming | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/IT/BT/C105 | Fundamentals of Information Technology | | | | | | | | | |
| 6 | AECC206 | *General English | 2 | - | - | 10 | 20 | 30 | 70 | 100 | 2 |
| 7 | SET/ME/BT/C206 | Basic Mechanical Engineering Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/EE/BT/C107 | Basic Electrical Engineering Lab | | | | | | | | | |
| 8 | SET/SH/BT/C207 | Chemistry Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/SH/BT/C106 | Physics Lab | | | | | | | | | |
| 9 | SET/CS/BT/C208 | Computer Programming Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/IT/BT/C108 | Information Technology Lab | | | | | | | | | |
| 10 | SET/ME/BT/S209 | **Engineering Workshop | - | - | 4 | 30 | - | 30 | 70 | 100 | 2 |
| | | | | | | | | | | **Total** | 22 |

* Humanities and Social Sciences including Management courses.

**Skill Enhancement Course.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| **SET/SH/BT/C201. MATHEMATICS II** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Multiple Integral** | Double and triple integrals, change of order of integration. Change of variables, application to area, volume, centre of gravity, moment of inertia and product of inertia. Gamma and Beta functions, Drichlet's integral and its application. | 9 |
| **Fourier Series** | Periodic functions, Fourier series of functions with period 2n, change of interval, half range sine and cosine series. | 6 |
| **Integral Transform** | Laplace transforms, existence theorem, Laplace transform derivatives, inverse Laplace transform, application to solve linear differential equations, unit step function, Dirac delta function, Laplace transforms of periodic functions. Application of Laplace transforms. Definitions of Fourier and Z-transform and its simple applications. | 12 |
| **Ordinary Differential Equations** | Introduction to order, degree and arbitrary constants, linear differential equations of n" order with constant coefficient, complimentary functions and particular integrals. Homogeneous differential equations, simultaneous linear differential equations. Solutions of second order differential equations by changing dependent and independent variables. Method of variation of parameters, equations of the form y" = f(y), applications to engineering problems. | 12 |
| **Solutions of Equations and Curve Fitting** | Solutions of cubic and bi-quadric equations. Method of least square and curve fitting. | 6 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers.<br>2. H K Das, "Advanced Engineering Mathematics", S Chand.<br>3. Erwin Kreyszig, "Advanced Engineering Mathematics". | |
| **References** | 1. J. N. Kapoor, "A Text Book of Differential Equations". | |

| SET/ME/BT/C202. BASIC MECHANICAL ENGINEERING | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Laws of Thermodynamics** | Concept of temperature, equality of temperature, Zeroth law, principles of thermometry and temperature scale. First law of thermodynamics, concept of internal energy, application of first law to a closed system to various processes, flow processes and control volume, flow work, steady flow energy equation, mechanical work in steady flow process, throttling process, application of first law to open system. Essence of second law, thermal reservoir, heat engines and thermal efficiency. COP of heat pump and refrigerator, definition of available and unavailable energy. Statement of second law, Carnot cycle, Carnot's theorem, Clausius inequality, concept of entropy, entropy changes for ideal gases. | 8 |
| **Properties of Steam** | Generation of steam at constant pressure, various states of water, steam, properties of steam, use of property diagram, processes of vapour in closed and open system, determination of dryness fraction of steam by separating and throttling calorimeter, Rankine cycle. | 5 |
| **Thermodynamic Cycle** | Definitions of bore, stroke, clearance ratio, compression ratio, definition and calculation of mean effective pressure from the cyclic work (proof not required), indicated pressure, air standard cycle (Otto and diesel cycle), principle of working and description of two and four stroke S.I. and C.I. engine. | 8 |
| **Strength of Material- Simple Stresses and Strains** | Stress- tensile and compressive, strain, strain energy, stress-strain diagram, ductile and brittle material, elastic constants, impact loading, varying cross-section and load, temperature stresses, shear stress, complementary shear stress, shear strain. | 8 |
| **Compound Stresses and Strains** | State of stress at a point, oblique stress, simple tension, pure shear, general two dimensional stress system, principal planes, principal stresses and strains, Mohr's stress circle, Poisson's ratio, maximum shear stress. | 8 |
| **Bending Stress and Torsion** | Pure bending, moment of inertia, section modulus, bending stresses, combined bending and direct stress, beam of uniform strength, middle third and middle quarter rules for rectangular and circular sections, Circular shafts, torsional shear stress, strain energy in torsion, shafts under varying torque, compound shafts, combined bending and twisting. | 8 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. R S Khurmi, "Engineering Mechanics".<br>2. P K Nag "Engineering Thermodynamics". | |
| **References** | 1. Van Wylen G.J. & Sonnlog R.E.: Fundamentals of classical thermodynamics, John Wiley & Sons,Inc. NY.<br>2. Wark Wenneth : Thermodynamics (2nd edition), Mc Graw Hill book Co. NY.<br>3. Holman, J.P.: Thermodynamics, MC Graw Hill book Co. NY.<br>4. Yadav R.: Thermodynamics and Heat Engines, Vol I & II (Sl Edition) Central Publishing House Allahabad.<br>5. Yadav R.: Steam & Gas Turbines.<br>6. Kshitish Chandra Pal: Heat Power, Orient Longman Limited, 17, Chittranjan Avenue, Calcutta.<br>7. S. Rao, B.B. Parulekar, 'Energy Technology', Khanna Pub., New Delhi.<br>8. G. H. Ryder: "Strength of Materials".<br>9. F. L. Singer: "Strength of Materials".<br>10. Timoshenko: "Strength of Materials".<br>11. Beer, Johnson, Statics". | |

| SET/SH/BT/C203. CHEMISTRY | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Thermodynamics** | Terminology in Thermodynamics, Zeroth law of Thermodynamics, First law of Thermodynamics, Enthalpy, Reversible isothermal expansion of ideal gas, Adiabatic expansion of ideal gas, Joule-Thomson effect. | 4 |
| **Lubricants** | Theory, classification and mechanism of lubrication. | 4 |
| **Polymers** | Structures of the following polymers, viz, Natural and synthetic rubbers, Polyamide and Polyester fibres, polymethylmethacrylate, poly acrylonitrile and polystyrene. A brief account of conducting polymers (polypyrrole & polythiophene) & their applications. | 3 |
| **Complex Compounds** | Introduction, Valence bond and crystal field theory for bonding in complexes. | 4 |
| **Chemical Kinetics & Catalysis** | Order and molecularity of reactions, Catalysis- homogeneous and heterogeneous catalysis. Characteristics of catalytic reactions, catalytic promoters and poisons, auto catalysis and negative catalysis. Activation energy of catalysis, intermediate compound formation theory and adsorption theory. | 3 |
| **Atmospheric Chemistry& Air Pollution** | Environment and ecology, environmental segments, structure and composition of atmosphere, radiation balance of earth and Green House Effect, formation and depletion of Ozone layer, chemical and photochemical reactions of various species in atmosphere, air pollution- sources, reactions and sinks for pollutants, acid rains and smog formation. Pollution control methods. | 5 |
| **Corrosion** | Introduction, causes of corrosion, theories of corrosion- direct chemical attack, electrochemical theory of corrosion, factors influencing corrosion, passivity, types of corrosions, protection from corrosion (Cathodic and anodic protection) and protective metallic coatings (Galvanizing and tinning). | 5 |

| | | |
|---|---|---|
| **Water and Waste Water Chemistry** | Introduction, Hardness of Water, Characteristics Imparted by Impurities, Determination of hardness by EDTA method, Treatment of Water by Zeolite, L-S Process, Boiler problems caused by use of hard Water, Reverse osmosis process for purification of water. Numerical based on hardness of water, zeolite process and Lime-soda process. | 6 |
| **Fuels & Combustion** | Classification of Fuels, Non-Conventional Energy, Biogas, and Solar Energy, Calorific value – Gross and Net, Characteristics of Good Fuel, Determination of Calorific Value by bomb calorimeter method (theory and numerical), Solid Fuels: Analysis of Coal (Proximate and ultimate analysis of coal theory and numerical), Liquid Fuels: mining and refining of petroleum, cracking (Thermal and catalytic), Knocking, octane and cetane number . | 5 |
| **Stereochemistry of Organic-Compounds** | Mechanism of Chemical Reaction, Beckman, Hoffman, Reimer Tiemann, Cunnizzaro, Diels- Alder and Skraup synthesis. | 4 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. Jain, Jain, "Engineering Chemistry".<br>2. Sharma, Kumar, "Engineering Chemistry". | |
| **References** | 1. R. T. Morrison and R N Boyd, "Organic Chemistry", 6th Edition, Prentice Hall, New Delhi.<br>2. J. D. Lee, "Concise Inorganic Chemistry", Chapman & Hall.<br>3. W. L. Jolly, "Modern Inorganic Chemistry", McGraw-Hill.<br>4. P.W. Atkins, "Physical Chemistry", 6th Edition, Oxford University Press.<br>5. Barrow, "Physical Chemistry".<br>6. Manahan, "Environmental Chemistry".<br>7. D. L. Pavia, GM. Lampman, GS. Kriz and J.R Vyvyan, I, "Spectroscopy", Cengage Learning India Pvt. Ltd, New Delhi, 2007.<br>8. R.M. Silverstein, F.X. Webster and D.J. Kiemle, "Spectrometric Identification of Organic Compounds", 7th edition, John-Wiley and Sons, New York, 2005.<br>9. William Kemp, "Organic Spectroscopy", 3rd edition, Palgrave, New York, 2005.<br>10. C.N. Banwell and E. M. McCash, "Fundamentals of Molecular Spectroscopy", McGraw- Hill, International, UK, 1995.<br>11. F. Carey, "Organic Chemistry", 5th Edition, McGraw Hill Publishers, Boston, 2003. | |

| **SET/ME/BT/C204. ENGINEERING MECHANICS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Force System** | Introduction: Force system, dimensions and units in mechanics, laws of mechanics, vector algebra, addition and subtraction of forces, cross and dot products of vectors, moment of a force about a point and axis, couple and couple moment, transfer of a force to a parallel position, resultant of a force system using vector method, Problems involving vector application Equilibrium: Static and dynamic equilibrium, static in determinacy, general equations of equilibrium, Varingnon's theorem, Lami's theorem, equilibrium of bodies under a force system, Problems. | 10 |
| **Trusses And Frames** | Truss and Frames: Truss, classification of truss, assumptions in truss analysis, perfect truss, analysis of perfect plane truss using method of joints and method of sections, Problems. | 10 |
| **Centre Of Gravity And Moment Of Inertia** | Centroid, Centre of mass and Centre of gravity, Determination of centroid, centre of mass and centre of gravity by integration method of regular and composite figures and solid objects, Problems, Moment of Inertia: Area moment of inertia, mass moment of inertia, parallel axis and perpendicular axis theorems, radius of gyration, polar moment of inertia, product of inertia, principle axis, problem based on composite figures and solid objects. | 13 |
| **Kinematics And Dynamics** | Kinematics: Concept of rigid body, velocity and acceleration, relative velocity, translation and rotation of rigid bodies, equations of motion for translation and rotation, problems. Particle Dynamics: Energy methods and momentum methods, Newton's laws, work energy equation for a system of particles, linear and angular momentum equations, projectile motion, problem. | 12 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. R S Khurmi, "Engineering Mechanics".<br>2. P K Nag "Engineering Thermodynamics". | |
| **References** | 1. Van Wylen G.J. & Sonnlog R.E.: Fundamentals of classical thermodynamics, John Wiley & Sons,Inc. NY.<br>2. Wark Kenneth: Thermodynamics (2nd edition), Mc Graw Hill book Co. NY.<br>3. Holman, J.P.: Thermodynamics, MC Graw Hill book Co. NY.<br>4. Yadav R.: Thermodynamics and Heat Engines, Vol I & II (Sl Edition) Central Publishing House Allahabad.<br>5. Yadav R.: Steam & Gas Turbines.<br>6. Kshitish Chandra Pal: Heat Power, Orient Longman Limited, 17, Chittranjan Avenue, Calcutta.<br>7. S. Rao, B.B. Parulekar, 'Energy Technology', Khanna Pub., New Delhi.<br>8. G. H. Ryder: "Strength of Materials".<br>9. F. L. Singer: "Strength of Materials".<br>10. Timoshenko: "Strength of Materials".<br>11. Beer, Johnson, Statics. | |

| SET/CS/BT/C205. COMPUTER PROGRAMMING | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | C Character Set, Identifiers and Keywords, Data Types, Declarations, Expressions, Statements and Symbolic Constants. | 6 |
| **Operators and Expressions** | Arithmetic, Unary, Relational, Logical, and Assignment Operators, Conditional Operator, Library Functions. | 6 |
| **Control Statements** | While, Do-while, For Statements, Nested Loops, If-Else, Switch, Break, Continue and Go to Statements, Comma Operator. | 5 |
| **Functions** | Defining and Accessing Functions, Function Prototypes, Passing Arguments, Recursion, and Use of Library Functions. | 5 |
| **Program Structure** | Storage classes, Automatic, External, Static Variables. | 4 |
| **Arrays** | Defining and Processing, Passing to a Function, Multidimensional Arrays, Arrays and Strings. | 4 |
| **Pointers** | Declarations, Passing to a Function, Operations on Pointers, Pointers and Arrays, Dynamic Memory Allocation, Array of Pointers. | 6 |
| **Structures and Unions** | Basics of Structures, Structures and Functions, Arrays of Structures, Pointers to Structures, Self Referential Structures, type definitions, Unions. | 4 |
| **Data Files** | Open, Close, Create, Process, Unformatted data files. | 4 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. E. Balagurusamy, "Programming in ANSI C". | |
| **References** | 1. Byron S. Gottfried, "Programming With C".<br>2. Yashwant Kanitker, "LET US C".<br>3. B. W. Kernighan and D. M. Ritchie, "The C Programming Language".<br>4. B. W. Kernighan, "The Practice of Programming", Addison-Wesley, 1999.<br>5. C. L. Tondo and S. E. Gimpel, "The C Answer Book", (2/e), Prentice Hall, 1988. | |

| AECC206. GENERAL ENGLISH | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| Introduction: | Theory of Communication, Types and modes of Communication | 6 |
| Language of Communication | Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication | 6 |
| Speaking Skills | Monologue Dialogue Group Discussion Effective Communication/ Mis- Communication Interview Public Speech | 7 |
| Reading and Understanding | Reading and Understanding Close Reading Comprehension Summary Paraphrasing Analysis and Interpretation Translation(from Indian language to English and vice-versa) Literary/Knowledge Texts | 7 |
| Writing Skills | Documenting Report Writing Making notes Letter writing | 4 |
| | **Total No. of Hours** | **30** |
| Textbooks | 1. Fluency in English - Part II, Oxford University Press, 2006.<br>2. Business English, Pearson, 2008.<br>3. Language, Literature and Creativity, Orient Blackswan, 2013.<br>4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas | |

| SET/ME/BT/C206. BASIC MECHANICAL ENGINEERING LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Study of boiler models – Babcock Wilcox, Lancashire and Locomotive.<br>2. Study of Steam Engine and Steam Turbine models.<br>3. Study of 2-Stroke and 4-Stroke ICE models.<br>4. Study of vapour compression Refrigeration unit tutor.<br>5. Study of window type air conditioner.<br>6. To conduct the tensile test on a UTM and determine ultimate tensile strength, percentage elongation for a steel specimen.<br>7. To conduct the compression test and determine the ultimate compressive strength for a specimen.<br>8. To conduct impact test (Izod/Charpy) on the impact testing machine and find the impact strength.To determine the hardness of the given specimen using Brinell/Rockwell/Vicker testing machine. | 15x2 |
| **Total No. of Hours** | **30** |

| SET/SH/BT/C207. CHEMISTRY LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. To determine Saponification value of given oil sample.<br>2. To determine the ferrous content in the supplied sample of iron ore by titrimetric analysis against standard $K_2Cr_2O_7$ solution using $K_3Fe(CN)_6$ as external indicator.<br>3. To determine the chloride content in supplied water sample using Mohr's method.<br>4. To determine acid value of given oil sample.<br>5. To determine the total hardness of water sample by EDTA titration. | 15x2 |

| | |
|---|---|
| 6. To find chemical oxygen demand of a waste water sample using Potassium Dichromate.<br>7. Estimation of iron in plain carbon steel by redox titration.<br>8. Estimation of copper in brass by titration method.<br>9. Estimation of Zinc in brass by titration method.<br>10. Analysis of a coal sample by proximate analysis method. | |
| **Total No. of Hours** | **30** |

| **SET/CS/BT/C208. COMPUTER PROGRAMMING LAB** | |
|---|---|
| **Content** | **No. of Hrs.** |
| This lab shall have minimum 25 programs in C. There shall be minimum two programs per module as taught in theory. Programming shall follow logic/algorithm and flowchart wherever applicable. Exercises shall also enhance analytical and debugging abilities. | 14x2 |
| **Total No. of Hours** | **28** |

| **SET/ME/BT/S209. ENGINEERING WORKSHOP** | | |
|---|---|---|
| **Module** | **Content** | **No. of Hrs.** |
| **Module 1** | Mechanical Engineering covering, the following trades for experiments (with a minimum of two exercises under each trade) - Carpentry, Fitting, Tin-Smithy and Development of jobs carried out and soldering, Black Smithy, House Wiring, Foundry (Molding only), Plumbing. | 16X2 |
| **Module 2** | Power tools in Construction, Wood working, Electrical and Mechanical Engineering practices. | 8x2 |
| | **Total No. of Hours** | **48** |

## SEMESTER III

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE. | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C301 | Mathematics III | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/EC/BT/C302 | Electronic Devices and Circuits | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 3 | SET/EC/BT/C303 | Digital Electronics | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EC/BT/C303MOOC | Switching Circuits and Logic Design* | - | - | - | - | - | - | - | | |
| 4 | SET/EI/BT/C304 | Electrical Machines | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 5 | SET/EC/BT/C305 | Electromagnetic Field Theory | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EC/BT/C305MOOC | Applied Electromagnetics for Engineers* | - | - | - | - | - | - | - | | |
| 6 | SET/EI/BT/C306 | Electrical Measurements and Instrumentation | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 7 | SET/EC/BT/C307 | Digital Electronics Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 8 | SET/EI/BT/C308 | Electrical Measurements and Instrumentation Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 9 | SET/EC/BT/C309 | Electronic Devices and Circuits Lab | - | - | 1 | 30 | - | 30 | 70 | 100 | 1 |
| 10 | SET/EI/BT/C310 | Electrical Machines Lab | - | - | 1 | 30 | - | 30 | 70 | 100 | 1 |
| 11 | SET/MC/BT/M311 | Indian Constitution (**MC) | - | - | - | - | - | - | - | 100 | - |
| | | | | | | | | | | **Total** | 22 |

*MOOC Course, **Mandatory Course.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| SET/SH/BT/C301. MATHEMATICS III | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Ordinary Differential Equations** | ODE of 2nd order with constant coefficients both homogeneous and non-homogeneous types with applications to electrical and mechanical systems. Difference equations and their solutions by Z transform. Series solutions of ODE of 2nd orders with variable coefficients with special emphasis to the differential equations of Legendre, Bessel and Chebyser. Legendre's polynomials, Chabyshev polynomials and Bessel's functions and their properties. | 14 |
| **Integral Transforms** | Fourier transform and integral Hankel transforms and Hilbert transforms and their properties, some simple applications. | 7 |
| **Partial Differential Equations** | Linear PDE with constant coefficients of 2nd order and their classifications. PDE of parabolic, elliptic and hyperbolic type with illustrative examples. Separation of variables method for solving PDE, such as two dimensional heat equations, wave equations and Laplace equations. | 10 |
| **Functions of a Complex Variable** | Analytic functions, Cauchy Riemann equations, harmonic functions line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula derivatives of analytic function, Liouvilles theorem, fundamental theorem of algebraic representation of a function by power series, Taylor's & Laurant series, poles & singularity of zeros. Residue theorem, conformal mapping, linear fractional transformation, special linear tranctional transformations. | 14 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers.<br>2. H K Das, "Advanced Engineering Mathematics", S Chand.<br>3. Erwin Kreyszig, "Advanced Engineering Mathematics". wiley publications. | |
| **References** | 1. Paopoulis, "Signal Analysis", TMH. | |

| SET/EC/BT/C302. ELECTRONIC DEVICES AND CIRCUITS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Natural signals, need of amplification and linearity, concept of gain, decibel, bandwidth, power dissipation; Concept of biasing and small signal; dc and ac analysis, concept of small signal model, concept of input impedance, output impedance and their estimation; Circuit models for different amplifier types: voltage, current, transconductance, trans-resistance; Introduction to octagon of tradeoffs in analog circuits; | 4 |
| **Diodes and application** | Qualitative analysis of PN Junction diode in different bias conditions: no bias, forward, reverse, breakdown ; Current Voltage characteristic; Exponential Model, Piece wise linear model, constant voltage drop model, ideal diode model, Diode-large signal and small signal operation; Diode Circuits; Introduction and applications of Special Diodes: Zener Diode, Schottkey Diode, Photo Diode; Varactor Diode, Tunnel Diode, Light Emitting Diode; | 5 |

| | | |
|---|---|---|
| **BJT Amplifiers** | BJT operation and characteristics: active mode, saturation mode; BJT Models: large signal model, transconductance, small signal model, hybrid –π model, Ebres –Mall model; early effect; Amplifier: input impedance, output impedance, gain; Operating point analysis and design: simple biasing, resistive divider biasing, biasing with emitter degeneration, self bias, and design procedures; Analysis and Design of different topologies: CE, CE with emitter degeneration, CB, CC (Emitter follower); Multi-stage amplifier; Bipolar Cascode Amplifier, Bipolar current mirror; Bipolar differential amplifier; | 10 |
| **MOSFET Amplifiers** | MOSFET operation and characteristics: MOSFET as variable resistor, channel pinch off, derivation of I-V characteristics, triode and saturation region, transconductance; MOS device models: large signal model, small signal model, channel length modulation; comparison of Bipolar transistor and MOSFET; MOS Amplifier topologies and their comparison; DC and AC analysis of CS, CS with current source load, CS with diode connected load, CS with degeneration, CG, CD (source follower), and CMOS Cascode amplifier, MOS current mirror; MOS differential amplifier. | 10 |
| **Frequency Response** | Poles and zeroes in circuits, Bode plot, miller's theorem, high frequency models for BJT and MOSFET; transit or cut-off frequency of device; frequency response of CE and CS amplifier and calculation of their poles, zeroes; bandwidth, effect of frequency on I/O impedances. | 5 |
| **Feedback** | Negative feedback: gain desensitization, bandwidth extension, modification of I/O impedances, linearity improvement; types of amplifiers: voltage, trans-impedance, trans-conductance, and current amplifiers; Sense and return techniques; polarity of feedback; feedback topologies: voltage-voltage feedback, voltage-current feedback, current-voltage feedback, current-current feedback; Stability in feedback systems: problem of instability, stability condition, Nyquist stability criterion, phase margin, frequency compensation; Barkhousen condition for Oscillations, Sinusoidal oscillators. | 6 |
| **Power Amplifiers** | Distortion and efficiency; emitter follower as power amplifier; push-pull stage, high fidelity design using feedback; heat dissipation, thermal runaway; efficiency of emitter follower and push-pull stage; power amplifier classes; Tuned Amplifiers: basics, inductor losses, transformer coupled amplifiers, amplifier with multiple tuned circuits, cascode and CC-CB cascade, tuning, class C tuned amplifier. | 5 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. Sedra, Smith, "Microelectronic Circuits", Oxford University Press.<br>2. Behzad Razavi, "Fundamental of Microelectronic Circuits", Wiley. | |
| **References** | 1. Millman, Halkias, "Electronic Devices and Circuits".<br>2. B. G. Streetman, "Solid state Devices", Pearson.<br>3. David A. Bell, "Electronic Devices and Circuits".<br>4. R.L.Boylestad, L.Nashelsky, "Electronics Devices & Circuit Theory" PHI. | |

| **SET/EC/BT/C303. DIGITAL ELECTRONICS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Positional number system; Binary, octal and hexadecimal number systems; Methods of base conversions; Binary, octal and hexadecimal arithmetic; Representation of signed numbers; Fixed and floating point numbers. Definition and specification of combination logic; Truth table; Basic logic operation and logic gates; Binary coded decimal codes; Gray codes. | 6 |
| **Boolean Algebra and Switching Functions** | Basic postulates and fundamental theorems of Boolean algebra; Standard representation of logic functions - SOP and POS forms; Simplification of switching functions - K-map. | 4 |
| **Logic Families** | Diode, BJT and MOSFET as a switch. Introduction to different logic families; Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product; circuit description and operation; RTL; DTL,HTL,TTL and sub families , Brief idea of ECL, CMOS BI-CMOS. | 10 |
| **Combinational Logic** | Arithmetic modules: adders, subtractors and ALU; Design examples. Decoders, encoders, multiplexers and de-multiplexers; Parity circuits and comparators. | 6 |
| **Sequential Logic** | Basic sequential circuits- latches and flip-flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop and their inter-conversions; Timing hazards and races; Meta-stability; Analysis of state machines using D flip-flops and JK flip-flops; Definition of state machines, synchronous sequential logic, shift register, counters-ripple and mod counters. | 12 |
| **Semiconductor Memories** | RAM, ROM, Content Addressable Memory, Charge Coupled Device Memory. PLAs, PALs and their applications; Sequential PLDs and their applications. | 6 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Morris Mano, "Digital Design". Prentice Hall. | |
| **References** | 1. Taub, Schilieng, "Digital Integrated Electronics". McGraw-Hill Publication.<br>2. Anad Kumar, "Digital principles and application". Prentice Hall.<br>3. John F Wakerly, "Digital Design: Principles and Practices", Prentice Hall.<br>4. Thomas L. Floyd, "Digital Fundamentals", Pearson/ Prentice Hall.<br>5. Ronald J. Tocci, "Digital Systems: Principles and Applications", Pearson/ Prentice Hall.<br>6. Charles Roth, "Fundamentals of Logic Design", Jaico Publishing House. | |

| SET/EC/BT/C303MOOC. SWITCHING CIRCUITS AND LOGIC DESIGN | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Introduction to number systems and codes, error detection and correction, binary arithmetic; Switching primitives and logic gates, logic families: TTL, CMOS, memristors, all-optical realizations; Boolean algebra: Boolean operations and functions, algebraic manipulation, minterms and maxterms, sum-of-products and product-of-sum representations, functional completeness. | 10 |
| **Week 4-6** | Minimization of Boolean functions: K-map method, prime implicants, don't care conditions, Quine-McCluskey method, multi-level minimization, Design of combinational logic circuits: adders and subtractors, comparator, multiplexer, demultiplexer, encoder, etc., Representation of Boolean functions: binary decision diagram, Shannon's decomposition, Reed-Muller canonical form, etc., | 10 |
| **Week 7-9** | Design of latches and flip-flops: SR, D, JK, T. Master-slave and edge-triggered flip-flops. Clocking and timing issues, Synthesis of synchronous sequential circuits, Mealy and Moore machines, state minimization, Design of registers, shift registers, ring counters, binary and BCD counters, General counter design methodology. | 10 |
| **Week 10-12** | lgorithmic state machine and data/control path design, Asynchronous sequential circuits: analysis and synthesis, minimization, static and dynamic hazards, Testing and fault diagnosis in digital circuits: fault modeling, test generation and fault simulation, fault diagnosis, design for testability and built-in self-test. | 10 |
| | **Total No. of Hours** | **40** |

| SET/EI/BT/C304. ELECTRICAL MACHINES | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **DC Machines** | Constructing feature and principle of operation of shunt, series and compound generators and motors including emf equation and armature reaction. Performance characteristics of generators and motors, starting, speed control and breaking of motors. Two quadrant and four quadrant operation of motors, choice of dc motors for different applications, losses and efficiency. | 14 |
| **Transformers** | Basics of transformers, Equivalent circuit of transformers, Transformer and its phasor diagram with and without load, Auto transformers, Instrument transformers. | 8 |
| **Induction motors** | Starters for cage and wound rotor type induction motors, speed control and breaking, torque slip characteristics, single phase induction motors and methods of starting, principle and operation of three phase induction motor , Different methods of speed control. | 10 |
| **Synchronous Machines** | Construction, emf, effect of pitch and distribution, armature reaction and determination of regulation of synchronous generators, principle of motor operation, effect of excitation on line current (V-curves) method of synchronization, typical applications of ac motors in industries. | 12 |
| | **Total No. of Hours** | **44** |
| **References** | 1. Nagrath &Kothari, Electrical Machines, Tata McGraw Hill.<br>2. P. S. Bimbhra, Electrical Machine, Khanna Publications, Delhi.<br>3. B. L. Theraja, Electrical Techonology Vol-II. Tata McGraw Hill.<br>4. Cotton H., Advance Electrical Techonology, Wheeler & Co. | |

| SET/EC/BT/C305. ELECTROMAGNETIC FIELD THEORY | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Transmission Lines** | Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines. | 6 |
| **Maxwell's Equations** | Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface. | 6 |
| **Uniform Plane Wave** | Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector. | 9 |
| **Plane Waves at Media Interface** | Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary. | 7 |
| **Waveguides** | Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides. | 7 |
| **Antennas** | Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance | 8 |

| | | |
|---|---|---|
| | and radiation pattern of Hertz dipole, Hertz dipole in receiving mode. | |
| | **Total No. of Hours** | **43** |
| **References** | 1. R. K. Shevgaonkar, **"**Electromagnetic Waves**"**, Tata McGraw Hill, 2005.<br>2. D. K. Cheng, "Field and Wave Electromagnetics**"**, Addison-Wesley, 1989.<br>3. M. N.O. Sadiku, "Elements of Electromagnetics**"**, Oxford University Press, 2007.<br>4. C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.<br>5. C. A. Balanis, "Antenna Theory: Analysis and Design**"**, John Wiley & Sons, 2005. | |

| **SET/EC/BT/C305MOOC. APPLIED ELECTROMAGNETICS FOR ENGINEERS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Introduction to Applied EM theory, Lossless Transmission line equations, Frequency-domain behavior: Characteristic impedance of T-line, Reflection and transmission coefficients, Complete solution for sinusoidal propagation, More general T-lines, Attenuation and propagation coefficients, Transmission line techniques: Standing wave ratio (SWR) and line impedance, Visual aid: Smith Chart derivation, Smith chart applications: Impedance to admittance conversion, SWR and impedance calculation, Impedance matching techniques - Part 1, Impedance matching techniques - Part 2, T-lines in time-domain: Reflection from mismatched loads, Lattice diagram calculations, Pulse propagation on T-lines. | 10 |
| **Week 4-6** | Case study: High-speed digital signals on PCBs, Transients with reactive termination, Application: Time domain reflectometry, Review of Coordinate Systems, Review of Vector analysis -1, Review of Vector analysis -2, Vector fields -Part 1, Vector fields - Part 2, Overview and importance of Maxwells equations, Boundary conditions between two media, Solution of Laplaces and Poissons equation Analytical techniques, Solution of Laplaces and Poissons equation in two dimensions, Numerical solution of Laplaces equation: Finite difference method, Numerical technique: Method of moments, Quasi-statics: Does an ideal capacitor exist? | 10 |
| **Week 7-9** | Magnetostatic fields: Biot Savart and Amperes laws, Magnetic field calculations, Inductance and inductance calculation, Quasi-statics: Fields of a wire,Quasi-static analysis of skin effect, Uniform plane waves - one dimensional wave equation, Uniform plane waves: propagation in arbitrary direction, phase velocity, polarization, Plane waves in conductors an dielectric media, Reflection and transmission of plane waves at a planar interface, Oblique incidence and reflection of plane waves - s and p polarization, Total internal reflection and Snells laws, Application: Multilayer thin films, Application: Fabry-Perot cavity, Waveguides - General introduction, Rectangular metallic waveguide modes. | 10 |
| **Week 10-12** | Dispersion and attenuation, Dielectric planar waveguides, Case study: Optical fibers, Application: Fiberoptic communications, WDM optical components, Wave propagation in crystals and index ellipsoid, Wave propagation in Ferrites, Wave propagation in periodic structures: Diffraction, Vector potential and wave equation, Radiation by dipole, Fundamental Antenna parameters, Half-wave dipole, Antenna array and diffraction, Application: RFID, Looking ahead. | 10 |
| | **Total No. of Hours** | **40** |

| **SET/EI/BT/C306. ELECTRICAL MEASUREMENTS AND INSTRUMENTATION** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Electrical Instruments** | D'Arsonval Galvanometer. Working principle and operation of PMMC, MI, electrodynamometer and rectifier type instruments. Wattmeters - introduction, electrodynamics type wattmeter, theory, shape of scale, errors. Potentiometers - DC potentiometer - introduction, basic potentiometer circuit, laboratory type, multi-range, precision type, Vernier type, volt ratio box, applications. AC potentiometer - introduction, types, applications. Instrument transformers - introduction, use, ratios, burdens. Current transformers - relationships, errors. Potential transformer - introduction, relationships, errors. | 16 |
| **Measurements** | Measurement of voltage, current, power, power factor and energy. Measurement of resistance - measurement of low (Kelvin double bridge method), medium (ammeter-voltmeter, substitution, Wheatstone bridge & Ohmmeter method) and high resistance (guard circuit, direct deflection, loss of charge and Megohm bridge method) and earth resistance measurement. | 16 |
| **AC bridges** | Sources and detectors, general equation for bridge balance, general form of AC bridge. Self inductance bridges - Maxwell's inductance, Maxwell's inductance-capacitance, Hay's, Anderson and Owen's bridge. Capacitance bridges - Desauty and Schering bridges. Mutual inductance bridges – Heaviside and Campbell bridges. Frequency bridge – Wien's bridge. Sources of errors in bridge circuits. | 13 |
| | **Total No. of Hours** | **45** |
| **References** | 1. A K Sawhney, "Electrical and Electronic Measurements and Instrumentation"<br>2. E. W. Golding & F. E. Widdis, "Electrical Measurements and Measuring Instruments" | |

| SET/EC/BT/C307. DIGITAL ELECTRONICS LAB | | |
|---|---|---|
| **Content** | | **No. of Hrs.** |
| 1. Combinational Logic design using basic gates (Code Converters, Comparators).<br>2. Combinational Logic design using decoders and MUXs.<br>3. Arithmetic circuits - Half and full adders and subtractions.<br>4. Arithmetic circuits – design using adder ICs, BCD adder.<br>5. Flip flop circuit (RS latch, JK & master slave) using basic gates.<br>6. Asynchronous Counters.<br>7. Synchronous counters, Johnson & Ring counters.<br>8. Sequential Circuit designs (sequence detector circuit).<br>9. Transfer Characteristics, Measurement of Sinking and Sourcing currents etc. of TTL gates. | | 10x2 |
| **ModelSim Simulations** | Writing and simulating programs for adder, decoder, multiplexer, de-multiplexer, up/down counter, universal shift register, Sequence Detector etc. | 4x2 |
| | **Total No. of Hours** | **28** |

| SET/EI/BT/C308. ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Study of electrical instruments: MI, PMMC, Dynamometer, wattmeter. Energy meter, potentiometer and instrument transformer.<br>2. Calibration of instruments: AC voltmeter and ammeter.<br>3. Wheatstone bridge and Kelvin's Bridge for Measurement of Resistance.<br>4. Schering Bridge for Capacitance Measurement and Anderson Bridge for Inductance Measurement.<br>5. Calibration of Single-phase Energy meter and Wattmeter.<br>6. Testing of Current Transformer. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/EC/BT/C309. ELECTRONIC DEVICES CIRCUITS LAB | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Experiments** | 1. Clipping and clamping circuits.<br>2. Half wave, Full wave rectifiers Bridge Rectifiers.<br>3. BJT and JFET Biasing schemes and Bias Stability comparison.<br>4. Emitter follower – frequency and phase response.<br>5. Single stage BJT amplifier – Frequency Response.<br>6. Single stage JFET amplifier – Frequency Response.<br>7. Power amplifier – Class A, Class B, ClassAB and Class C.<br>8. Two stage RC coupled amplier – Frequency Response.<br>9. Cascode Amplifier – Frequency Response.<br>10. Feedback Topologies and amplifiers.<br>11. Phase Shift Oscillator.<br>12. Colpitts/Hartley Oscillators.<br>13. Astable, Monostable and Bistable Multivibrator with BJT. | 10x2 |
| **Spice Simulations** | 1. Clipping and clamping circuits.<br>2. Bridge rectifier.<br>3. Common emitter amplifier with voltage divider biasing- dc, transient, ac analysis.<br>4. Inverting, Non-Inverting, Difference, Instrumentation Amplifiers. | 4x2 |
| | **Total No. of Hours** | **28** |

| SET/EI/BT/C310. ELECTRICAL MACHINES LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Open circuit characteristic of DC Shunt Generator.<br>2. Load test on DC Shunt Generator.<br>3. Speed control of DC Shunt Motor.<br>4. Brake test on DC Shunt Motor.<br>5. Load test on Single - phase Transformer.<br>6. Load test on three - phase Induction Motor.<br>7. Brake test on Single - phase Induction Motor.<br>8. Open Circuit test.<br>9. Short circuit test.<br>10. Speed control of three phase Induction motor. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/MC/BT/M311. INDIAN CONSTITUTION | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy | 6 |
| **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 | 6 |
| **State Government and its Administration** | Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and<br>Functions | 4 |
| **Local Administration** | District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected<br>Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy. | 8 |
| **Election Commission** | Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State<br>Election Commission: Role and Functioning, Institute and<br>Bodies for the welfare of SC/ST/OBC and women | 6 |
| | **Total** | **30** |

## SEMESTER IV

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C401 | Sensors and Transducers | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/EC/BT/C402 | Analog Integrated Circuits | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 3 | SET/EI/BT/C403 | Microprocessors and Interfacing | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 4 | SET/EI/BT/C404 | Analytical Instruments | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 5 | SET/EI/BT/C405 | Signals and Systems | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EI/BT/C405MOOC | Principles of Signals and Systems* | - | - | - | - | - | - | - | | |
| 6 | SET/EI/BT/C406 | Circuit Theory | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EI/BT/C406MOOC | Network Analysis* | - | - | - | - | - | - | - | | |
| 7 | SET/EI/BT/C407 | Sensors and Transducers Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 8 | SET/EI/BT/C408 | Microprocessors and Interfacing Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 9 | SET/EI/BT/C409 | Analytical Instruments Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 10 | SET/EI/BT/C410 | Signals and Networks Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 11 | SET/MC/BT/M411 | Essence of Indian Traditional Knowledge (**MC) | - | - | - | - | - | - | - | 100 | - |
| | | | | | | | | | | **Total** | 22 |

*MOOC Course, **Mandatory Course.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| SET/EI/BT/C401. SENSORS AND TRANSDUCERS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Sensors and Transducers; Types of sensors and transducers; Characteristics of transducers, static calibrations, mathematical model of transducers, 0, 1st, 2nd order transducers, response to step, ramp and impulse inputs. | 6 |
| **Measurement & Error Analysis** | Units and standards, calibration techniques, classification of errors. Static and dynamic characteristics - accuracy, repeatability, hysteresis, resolution, reproducibility, precision etc. | 5 |
| **Displacement, Speed, Velocity** | Resistive transducers, Potentiometric, metal and semiconductor strain gauges, strain gauge applications; inductive transducers, Transformer type, LVDT, synchros, eddy current | 12 |

| | | |
|---|---|---|
| **and Acceleration Measurement** | transducers, proximity detectors; capacitive transducers; Relative velocity, translational & rotational velocity measurement, revolution counters & timers, magnetic & photoelectric pulse counting, Tacho generators, stroboscopic methods. Basics of Gyroscope; Accelerometers – seismic, piezoelectric; Hall effect sensors, Magnetostrictive transducers. | |
| **Force, Power, Torque, Shock & Vibration Measurement** | Force measurement, analytical balance, weighing systems and weighers, spring balance, load cell, pneumatic load cell, magneto-elastic load cell, piezoelectric load cell, elastic load cell. Torque measurement - mechanical, optical and electrical methods. Power measurement-dynamometers. Vibration measurement, vibrators shaper, piezo-electric and variable reluctance pick-ups. | 10 |
| **Signal Conditioning** | Instrumentation amplifier, lock-in amplifier, charge amplifier; Active and Passive Filters- 1st, 2nd order filters, LP, HP, notch, all pass filters, Butterworth, elliptic, Bessel and chebyshev filters. | 12 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. Murthy D. V. S, "Transducers and Instrumentation", Prentice Hall, New Delhi, 1995. | |
| **References** | 1. Renganathan, S., "Transducer Engineering", Allied Publishers, 2003.<br>2. Patranabis, "Sensors and Transducers", 2nd Edition, Prentice Hall India Pvt. Ltd., 2003.<br>3. C. S. Rangan, V. S. V. Mani & G. R. Sharma, "Instrumentation Devices and Systems". Mcgraw Hill Education.<br>4. A K Sawhney, "Electrical and Electronic Measurement and Instrumentation". Dhanpat Rai Publication.<br>5. John P. Bentley, "Principles of Measurement Systems", 3rd Edition, Pearson Education.<br>6. H. K. P. Neubert, "Instrument Transducers". Oxford University Press<br>7. E. O. Doebelin, "Measurement Systems Application and Design", McGraw Hill publications.<br>8. P. Horowitz & W. Hill, "The Art of Electronics", Cambridge Press publications. | |

| **SET/EC/BT/C402. ANALOG INTEGRATED CIRCUITS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Operational Amplifiers, DC and AC characteristics; Applications of Op-amp: Precision rectifiers, Log and antilog amplifiers, four quadrant multipliers. Instrumentation amplifier, Sample and Hold Circuits. | 9 |
| **Active filters** | Introduction to filters. Butterworth, Chebyshev & Bessel filter; LC ladder filter – prototype & synthesis; Frequency transformation of low pass filter. Impedance converters; Gm-C filters, Active-RC Filters; Switched capacitor filter. | 8 |
| **Multivibrators and Pulse shaping circuits** | Multivibrators using op amps; 555 timer; Triggering circuits for bistable and monostable multivibrators; Programmable timer; Pulse shaping circuits. | 6 |
| **PLL** | Analog multiplexer, PLL and its applications, Frequency synthesizers, Coherent synthesizers using PLL, Direct digital synthesis, Phase noise in oscillators. | 6 |
| **Power supply Regulators** | Voltage regulators, Regulators using op amps, IC regulators, Protection circuits, Foldback current limiting, current boosting of IC regulators, switching regulators. | 6 |
| **DACs and ADCs** | D/A Converter – General considerations, Static non-idealities and Dynamic non-idealities; Current-steering DAC – Binary weighted DAC, Design issues, Effect of Mismatches. A/D converter – General considerations, static and dynamic non-idealities; Flash ADC – Basic architecture, Design issues, Comparator and Latch, Effect of non-idealities, Interpolative and folding architectures. Successive Approximation ADC; Pipeline ADC. | 7 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. S.Franco, Design with Operational Amplifiers and Analog Integrated Circuits (3/e) TMH, 2003.<br>2. R.Gayakwad, Op-amps and Linear Integrated Circuits (4/e), PHI.<br>3. Coughlin, Op-amps and Analog Integrated Circuits, PHI. | |
| **References** | 1. D.A.Bell, Solidstate Pulse Circuits (4/e), PHI.<br>2. M.E. Van Valkenburg, Analog Filter Design, Oxford University Press, 1995.<br>3. R. Schaumann and M.E. Van Valkenburg, Design of Analog Filters, Oxford University Press, 2003.<br>4. BehzadRazavi, Principles of Data Conversion System Design, Wiley-IEEE Press, 1995.<br>5. Rudy J. van de Plassche, CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters, Springer, 2003.<br>6. Choudhury, R. and Jain, S., "Linear Integrated Circuits", 3rd Edition. | |

| **SET/EI/BT/C403. MICROPROCESSORS AND INTERFACING** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Architecture:** | General 8-bit microprocessor and its architecture (8085, Z-80, Motorola 6800 CPU), functional block diagram, architecture, functions of different sections, instruction format, addressing modes, instruction set of 8085 CPU, instruction cycle, timing diagrams, different machine cycles, fetch and execute operations, estimation of execution time. | 10 |
| **Assembly Language Programming:** | Assembly format of 8085, assembly directives, simple programming practices, stack and subroutines. | 8 |
| **Data Transfer & Interfacing:** | Data transfer schemes, programmed I/O, interrupt structure of 8085, and interrupt driven I/O, DMA, serial I/O, input/output ports, using latches and buffers, peripheral interface ICs: 8255, 8251, 8279, 8259, interfacing of A/D and D/A converters, RAM and ROM. | 12 |

| | | |
|---|---|---|
| **Display Devices. Applications:** | Data acquisition systems, temperature control, waveform generation and stepper motor control. | 8 |
| **DACs and ADCs** | D/A Converter –Binary weighted DAC, Design issues, Effect of Mismatches. A/D converter – General considerations, static and dynamic non-idealities; | 4 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1 S.Franco, Design with Operational Amplifiers and Analog Integrated Circuits (3/e) TMH, 2003.<br>2 R.Gayakwad, Op-amps and Linear Integrated Circuits (4/e), PHI.<br>3 Coughlin, Op-amps and Analog Integrated Circuits, PHI. | |
| **References** | 1. D.A.Bell, Solidstate Pulse Circuits (4/e), PHI.<br>2. M.E. Van Valkenburg, Analog Filter Design, Oxford University Press, 1995.<br>3. R. Schaumann and M.E. Van Valkenburg, Design of Analog Filters, Oxford University Press, 2003.<br>4. BehzadRazavi, Principles of Data Conversion System Design, Wiley-IEEE Press, 1995.<br>5. Rudy J. van de Plassche, CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters, Springer, 2003.<br>6. Choudhury, R. and Jain, S., "Linear Integrated Circuits", 3rd Edition. | |

| **SET/EI/BT/C404. ANALYTICAL INSTRUMENTS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Colorimeters and Spectrophotometers** | Electromagnetic radiation, Beer Lambert law, absorption instruments, colorimeters, UV - Visible, IR spectrophotometers, general sources of error, sources of error in spectrophotometric measurements, calibration. | 7 |
| **Flame Photometer** | Principle of flame photometry, constructional details of flame photometers, clinical flame photometers, interferences in flame photometry, procedure for determinations. | 6 |
| **Atomic Absorption Spectrophotometers** | Theoretical concepts, atomic absorption instrumentation, sources of interferences. | 6 |
| **Environmental Pollution Monitoring Instruments and Gas Analyzers** | Analysis of CO, NOx, SO2, hydrocarbons. Paramagnetic oxygen analyzer, thermal conductivity analyzers. Chromatography - HPLC. | 7 |
| **Mass Spectrometers** | Basic mass spectrometer, different types of mass spectrometers, components of a mass spectrometer, resolution. | 5 |
| **Nuclear Magnetic Resonance** | Principle of NMR, constructional details of NMR spectroscopy, sensitivity enhancement for analytical NMR spectroscopy. | 5 |
| **Radiation Detectors** | Ionization chamber, GM counters, proportional counter, scintillation counter, solid state detectors. | 3 |
| **Other Instruments** | pH meters, selective-ion electrodes; Principle, construction and working of SEM, XRD. | 5 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Willard, H.H., Merit, L.L., Dean J.A. and Seattle F.L., "Instrumental Methods of Analysis", CBS Publishing and Distribution.<br>2. R S Khandpur, "Handbook of Analytical Instruments". McGraw-Hill Education. | |
| **References** | 1. Settle, F.A., "Handbook of Instrumental Techniques for Analytical Chemistry", Prentice Hall.<br>2. Skoog, D.A. and West D.M., "Principles of Instrumental Analysis". J. Chem. Educ., 1981. | |

| **SET/EI/BT/C405. SIGNALS AND SYSTEMS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to signals** | Classification of signals, basic continuous- time and discrete- time signals, step and impulse functions, transformation of independent variable. Sampling, Quantization, Encoding; Sampling theorem. | 8 |
| **Introduction to systems** | Properties of systems, classification of systems, mathematical model for systems, normal form of system equations, initial conditions; Impulse response of a physical system, Introduction to convolution, Convolution integral, numerical convolution. , auto correlation function, properties of auto correlation function, cross correlation functions, properties of cross correlation functions. | 8 |
| **Fourier Analysis** | Representation of signals in terms of elementary signals, condition for orthogonality, representation of signals by elementary sinusoids, Fourier series representation, power spectrum, Fourier Transform, system function, energy spectrum, Calculation of simple transforms, Discrete Fourier Transform (DFT), properties of Discrete Fourier Transform. | 12 |
| **Laplace Transform** | Convergence of laplace transform, Properties of laplace transform, inversion of laplace transform, solution of differential equation, bilateral laplace transform. | 8 |
| **Z-transform** | Z-transform, convergence of Z-transform, properties of Z-transform, inversion of Z-transform, evaluation of system frequency response, applications of Z-transform. | 8 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Simon Haykin, "Signals & Systems", John Wiley publications.<br>2. Oppenheim, Wilskey, "Signals and Systems", PHI publications. | |
| **References** | 1. B.P.Lathi, "Linear systems and signals", OUP publications.<br>2. Paopoulis, "Signal Analysis", TMH publications. | |

| SET/EI/BT/C405MOOC. PRINCIPLES OF SIGNALS AND SYSTEMS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Introduction to Signals, Signal Classification, Continuous Discrete Time Signals, Definition and Classification of Systems, Linear Time Invariant (LTI) Systems, Properties of LTI Systems, Impulse Response, Convolution, Causality, Stability | 10 |
| **Week 4-6** | Impulse Response of Discrete Time Systems, Discrete Time Convolution, Difference Equations and Analysis, Laplace Transform, Properties of Laplace Transform, Inverse Laplace Transform, Introduction to z-Transform, Properties of z-Transform, Region of Convergence, Inverse z-Transform | 10 |
| **Week 7-9** | Introduction to Fourier Analysis, Fourier Series for Periodic Signals, Properties of Fourier Series, Introduction to Fourier Transform, Properties of Fourier Transform, Frequency Response of Continuous Time Systems, Examples of Frequency Response, Fourier Analysis of Discrete Signals, Discrete Time Fourier Transform (DTFT), Properties of DTFT, Examples of DTFT | 10 |
| **Week 10-12** | Frequency Response of Discrete Time Systems, Discrete Fourier Transform (DFT), Properties of DFT, Examples of DFT, - IIR FIR Filters, Direct Form Realization, Cascade and Parallel Form Realization, Problem Solving, Concept of State, State Space Analysis, State Space Representation of Continuous Time Systems, Solution of State Equations for Continuous Systems | 10 |
| | **Total No. of Hours** | **40** |
| **Textbooks** | 3. Simon Haykin, "Signals & Systems", John Wiley publications.<br>4. Oppenheim, Wilskey, "Signals and Systems", PHI publications. | |
| **References** | 3. B.P.Lathi, "Linear systems and signals", OUP publications.<br>4. Paopoulis, "Signal Analysis", TMH publications. | |

| SET/EI/BT/C406. CIRCUIT THEORY | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Networks and Transients** | Review of Network Theorems: Thevenin's & Norton's theorem - Superposition theorem - Maximum power transfer theorem – Reciprocity Theorem - Millman's theorem; Introduction to Network Topology: Definition of basic terms – Incidence matrix – Tie-sets - Cut-sets: Analysis and formulation of network equations using tie-set and cut-set; Transients in linear circuits: Initial Conditions - Zero state response - Zero input response - Complete Response – Analysis of RC and RL circuits with impressed DC voltage – RC network as differentiator and integrator - Compensated Attenuators – DC transients in RLC circuits. | 12 |
| **S-Domain Analysis and Network Functions** | S-Domain Analysis of Circuits: Review of Laplace transform - Transformation of a circuit into S-domain - Transformed equivalent of inductance, capacitance and mutual inductance - Impedance and admittance in the transform domain - Node analysis and mesh analysis of the transformed circuit; Network functions: Impulse response and Transfer function - Poles and Zeros – Restriction of pole and zero locations of network functions - Steady state response and Frequency response from Laplace transform. | 12 |
| **Two port networks** | Characterization in terms of impedance - Admittance - Hybrid and transmission parameters - Inter relationships among parameter sets - Interconnection of two port networks - Series, parallel and cascade. Symmetrical two port networks: T and π Equivalent of a two port network.<br>Symmetrical Two Port Reactive Filters: Filter fundamentals - Pass and stop bands - Constant - k low pass filter - Constant - k high pass filter-m-derived T and π sections and their applications for infinite attenuation and filter terminations - Band pass and band elimination filters. | 11 |
| **Network Synthesis** | Synthesis: Positive real functions - Driving point functions - Brune's positive real functions - Properties of positive real functions. Testing driving point functions - Application of maximum modulus theorems - Properties of Hurwitz polynomials - Even and odd functions - Strum's theorem - Driving point synthesis - RC elementary synthesis operations - LC network synthesis - Properties of RC network functions - Foster and Cauer forms of RC and RL networks. | 9 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. D. Roy Choudhary, Network and Systems, Wiley Eastern,. | |
| **References** | 1. Van Valkenburg M E, Network Analysis 3rd Edition, Prentice Hall.<br>2. Van Valkenberg M.E., Introduction to Modern Network Synthesis, John Wiley and Sons.<br>3. Franklin. F. Kuo, Network Analysis and Synthesis, John Wiley & sons.<br>4. | |

| SET/EI/BT/C406MOOC. NETWORK ANALYSIS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Introduction to Network, circuit elements & sources. KVL & KCL, Solution of linear differential equation with different excitation, Deeper look into energy storing elements, inductor and capacitor. | 10 |

| | | |
|---|---|---|
| **Week 4-6** | Ideal and practical voltage & current sources. Mesh and nodal analysis of networks. ransforming voltage to current source and vicr-versa. Thevenin / Norton's equivalent circuit. | 10 |
| **Week 7-9** | Tellegen Theorem and its implication. Theory of reciprocity. Network function. Two-port network: Z-parameters, Y-parameters, h-parameters & ABCD parameters. Definition of graph & tree of a network. Cut-set matrix. | 10 |
| **Week 10-12** | [A],[B] & [Q] matrices : Relationship among them, Tutorial -1, Tutorial-2 | 10 |
| | **Total No. of Hours** | **40** |
| **Textbooks** | 2. D. Roy Choudhary, Network and Systems, Wiley Eastern,. | |
| **References** | 5. Van Valkenburg M E, Network Analysis 3rd Edition, Prentice Hall.<br>6. Van Valkenberg M.E., Introduction to Modern Network Synthesis, John Wiley and Sons.<br>7. Franklin. F. Kuo, Network Analysis and Synthesis, John Wiley & sons.<br>8. Hayt, Kimmerly, Engineering Circuit Analysis, McGraw Hill.<br>9. Desoer C.A. & Kuh E.S., Basic Circuit Theory, McGraw-Hill.<br>10. Ryder J.D., Networks, Lines and Fields, Prentice Hall.<br>11. B. P. Lathi, Linear Systema and Signals, Oxford University Press.<br>12. DeCarlo, R.A., & Lin, "Linear Circuit Analysis", 2 nd Edition, OUP Indian Edition 2003.<br>13. Mahmood Nahvi, Joseph, A. Edminister, "Theory and Problems of Electric Circuits – Schaum's outline series", McGraw Hill.<br>14. Donald E. Scott, "An Introduction to Circuit analysis: A System Approach" McGraw Hill Book Company.<br>15. A.Chakrabarti,"Circuit Theory" Dhanpat Rai & Co. | |

| **SET/EI/BT/C407. SENSORS AND TRANSDUCERS LAB** | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Displacement vs. output voltage characteristics of a LVDT.<br>2. Strain gauge characteristics.<br>3. Characteristics of RTD, Thermistor.<br>4. Hall Effect transducer.<br>5. Linear velocity measurement using proximity sensor.<br>6. Angular velocity measurement using stroboscope, tachometer.<br>7. Torque measurement. | 14x2 |
| **Total No. of Hours** | **28** |

| **SET/EI/BT/C408. MICROPROCESSORS AND INTERFACING LAB** | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Familiarization with 8085 microprocessor kit and its keyboard.<br>2. Exercises with entry and manipulation of data (Different addressing modes).<br>3. Programming exercises using 8051 microcontroller.<br>4. Programming exercises to interface LCD with microcontroller.<br>5. Programming exercises using timers, counters, interrupts. Memory Interfacing.<br>6. Interfacing serial communication with PC using 8051.<br>7. Interfacing Stepper motor with 8051. | 14x2 |
| **Total No. of Hours** | **28** |

| **SET/EI/BT/C409. ANALYTICAL INSTRUMENTS LAB** | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Study of flame photometer.<br>2. Calibration and Measurement of samples using flame photometer.<br>3. Calibration and Measurement of samples using PH meter.<br>4. Study of XRD instrument.<br>5. Study of SEM instrument.<br>6. Study of Ellipsometer instrument. | 14x2 |
| **Total No. of Hours** | **28** |

| **SET/EI/BT/C410 SIGNALS AND NETWORKS LAB** | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Programming using MATLAB. | 10x2 |
| 2. Verification of principle of superposition with dc and ac sources.<br>3. Verification of Thevenin, Norton and Maximum power transfer theorems in ac circuits.<br>4. Verification of Tellegin's theorem for two networks of the same topology.<br>5. Determination of transient response of current in RL and RC circuits with step voltage input. | 4x2 |

| | |
|---|---|
| 6. Determination of frequency response of current in RLC circuit with sinusoidal ac input. | |
| **Total No. of Hours** | **28** |

| **SET/MC/BT/M411. ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Environment, Culture, Tradition &Practices** | i) Historical overview<br>ii) Oral &codified information on medicinal Plants<br>iii) Water & Water Bodies<br>iv) Fieldwork | 5 |
| **Urbanization &Urbanism** | i) Issues of settlements & Landscapes<br>ii) Social differentiations<br>iii) Communication networks | 5 |
| **Social inequality &Gender** | i) Status within Households: An overview<br>ii) Present context<br>iii) Issues of Violence | 6 |
| **Cultural Heritage** | i) Main components<br>ii) Built Heritage<br>iii) Historical Tourism<br>iv) Cultural Forms | 8 |
| **Cultural Forms &Cultural Expressions** | i) Performing Arts<br>ii) Fairs &Festivals<br>ii) Fieldwork | 8 |
| | **Total No. of Hours** | **32** |
| **References** | 1. Indu Banga, ed. The City in Indian History: Urban Demography, Society & Polity, Delhi, Manohar,,1991<br>2. Koch, E. Mughal Art & Imperial Ideology<br>3. Radha Kumar, History of Doing: An Illustrated Account of Movements for Women's Rights &Feminism in India 1880- 1990,Zubaan, 2007<br>4. V.Vasudev, Fairs &Festivals, Incredible India Series, 2007<br>5. V.Singh, The Human Footprint on Environment: Issues in India, New Delhi, and Macmillan, 2012<br>6. B. Parikh, Composite Culture in a multicultural Society, Delhi, NBT, 2007<br>7. N. Mehta, Introduction: Satellite Television, Identity & Globalization in Contemporary India in N.Mehta, ED, Television in India, New York, Routledge, 2008<br>8. R.C. Thakran & Sheo Dutt, ed Bhartiya Upmahaduip ki Sanskritiyan, University of Delhi | |

**SEMESTER V**

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C501 | Power Systems | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EI/BT/C501 MOOC | Power System Analysis* | - | - | - | - | - | - | - | | |
| 2 | SET/EI/BT/C502 | Control Systems | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EI/BT/C502 MOOC | Control Systems* | - | - | - | - | - | - | - | | |
| 3 | SET/EI/BT/C503 | Industrial Instrumentation | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 4 | SET/EI/BT/C504 | Power Electronics | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EI/BT/C504 MOOC | Power Electronics* | - | - | - | - | - | - | - | | |
| 5 | | PE-01 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 6 | SET/EI/BT/C506 | Power Systems Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 7 | SET/EI/BT/C507 | Control Systems Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 8 | SET/EI/BT/C508 | Industrial Instrumentation Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 9 | SET/EI/BT/C509 | Power Electronics Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 10 | SET/HS/BT/H510 | Foundations of Yoga (**HSMC) | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | | | | | | | | | | **Total** | 22 |

*MOOC Course,** Humanities and Social Sciences including Management courses.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 01 (PE-01)** | 1 | SET/EI/BT/E505 (i) | Electrical Drives |
| | 2 | SET/EI/BT/E505 (ii) | Line Commutated and Active PWM Rectifiers |
| | 3 | SET/EI/BT/E505 (iii) | Electrical Machine Design |

| **SET/EI/BT/C501. POWER SYSTEMS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to Power system** | Single line diagram of power system, Brief description of power system elements such as Synchronous Machine, Transformer; Busbar, Circuit Breaker etc., Per unit system and their application to power system network, Different kinds of supply system and their comparison; Choice of transmission voltage, conductor size, Kelvin's law. | 8 |
| **Transmission lines** | Conductor materials, Types of conductors, Parameters-Resistance, Inductance and capacitance of lines, Current distortion effects-Skin, Proximity etc., Mathematical Analysis of transmission lines., Interference with communication lines, Reduction Methods. | 8 |
| **Load flow Analysis** | Complex power,Y bus and Z bus formulation, Load flow analysis-Newton Raphson and fast decoupled methods, Methods of voltage control. | 6 |
| **Symmetrical and Unsymmetrical fault analysis** | Transient in R-L series circuit, Calculation of 3-phase short circuit current and reactance of synchronous machine, Internal voltage of loaded machines under transient conditions. Analysis of single line to ground fault, Line-to-line fault and double line to ground fault on an unloaded generators and power system network with and without fault impedance, Formation of $Z_{bus}$ using singular transformation and algorithm. | 10 |
| **Symmetrical Components** | Symmetrical components of unbalanced phasor, Power in terms of symmetrical components, Sequence impedances and sequence networks. | 2 |
| **Power System Stability** | Stability and stability limit, Steady state stability study, Derivation of Swing equation, transient stability studies by equal area criterion and step-by-step method, Factors affecting steady state and transient stability and methods of improvement. | 8 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994. | |
| **References** | 2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.<br>3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.<br>4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.<br>5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012. | |

| **SET/EI/BT/C501MOOC. POWER SYSTEM ANALYSIS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Structure of Power System and Few other Aspects, Resistance, Inductance, and Capacitance of Transmission Lines, Power System Components and Per Unit System. | 10 |
| **Week 4-6** | Characteristics and Performance of Transmission Lines, Load Flow Analysis. | 10 |
| **Week 7-9** | Optimal System Operation, Symmetrical Fault. | 10 |
| **Week 10-12** | Symmetrical Components, Unbalanced Fault Analysis, Power System Stability | 10 |
| | **Total No. of Hours** | **40** |
| **Textbooks** | 1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994. | |
| **References** | 2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.<br>3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.<br>4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.<br>5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012. | |

| **SET/EI/BT/C502. CONTROL SYSTEMS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Basics of Control** | Definitions of control systems, Classification of control systems, basic elements in control systems - open and closed loop system, transfer function, Laplace Transform, mathematical modeling and transfer function of different physical systems | 10 |
| **Control system parameters** | Time domain specifications, Transfer Function, Poles and Zeros. Response to various Inputs, Effect of Poles, effect of Zeros, Ist order system response, stability error coefficients, generalized error series, steady state error. | 10 |
| **Stability of Control Systems** | Characteristic equation, location of roots in S-plane for stability, Second Order Systems, Unit Step Response of Under damped Second Order Systems, Concepts of Rise Time, Peak Time, | 8 |

| | | |
|---|---|---|
| **and control design** | Maximum Peak Overshoot and Settling Time, Proportional (P), Integral (I) and Derivative (D) Blocks, Examples of PID controller design. | |
| **Stability Analysis And Its Applications** | Routh's Stability Criterion, Use in Control Design, Incorporation of Performance. Root Locus and its Application in Control Design. | |
| **Frequency Response** | Frequency response - definition, bode plot, polar plot, gain margin and phase margin, Nyquist stability criterion and application. | 8 |
| **State space analysis** | Lead, Lag and Lag-Lead Compensation, Concepts of state, state variable and state model, state transition matrix, concept of controllability and observability. | 8 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. I. G. Nagrath, M. Gopal, "Control Systems". Wiley, New York, 1983. | |
| **References** | 1. K. Ogata, "Modern Control Engg". PHI publications.<br>2. B. C. Kuo, "Automatic Control Systems". Prentice. Hall. | |

| **SET/EI/BT/C502MOOC. CONTROL SYSTEMS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1 – Week 3** | Introduction to Control, Classification of Dynamic Systems, Closed Loop Control System with Feedback, Mathematical Preliminaries – Complex Variables, Laplace Transform, Standard Inputs, Free and Forced Response, Transfer Function, Poles and Zeros, Response to various Inputs, Effect of Poles, Notion of Bounded Input Bounded Output (BIBO) stability. | 12 |
| **Week 4 – Week 6** | Effect of Zeros, Closed Loop Transfer Function, Dynamic Performance Specification, First Order Systems, Second Order Systems, Unit Step Response of Underdamped Second Order Systems, Concepts of Rise Time, Peak Time, Maximum Peak Overshoot and Settling Time, Controllers – Proportional (P), Integral (I) and Derivative (D) Blocks, Examples of PID controller design. | 12 |
| **Week 7 – Week 9** | Routh's Stability Criterion, Use in Control Design, Incorporation of Performance Specifications in Controller Design, Analysis of Steady State Errors, Root Locus and its Application in Control Design, Frequency Response, Bode Plots, Nyquist Plots. | 12 |
| Week 10 – Week 12 | Nyquist Stability Criterion, Relative Stability – Gain and Phase Margins, Control System Design via Frequency Response – Lead, Lag and Lag-Lead Compensation, Case Studies. | 12 |
| | **Total No. of Hours** | **48** |
| **Textbooks** | 1. I. G. Nagrath, M. Gopal, "Control Systems". Wiley, New York, 1983. | |
| **References** | 2. K. Ogata, "Modern Control Engg". PHI publications.<br>3. B. C. Kuo, "Automatic Control Systems". Prentice. Hall. | |

| **SET/EI/BT/C503. INDUSTRIAL INSTRUMENTATION** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Density & Viscosity Measurement** | Density measurement - strain gauge load cell method, buoyancy method, air-pressure balance method, Gamma ray method, vibrating probe method. Viscosity measurement - units of viscosity, specific gravity scales used in petroleum industries, different methods of measuring consistency & viscosity, Saybolt, Redwood, Engler, Rotameter type, rotating cylinder, cone and plate viscometer, industrial consistency meter, rotating wane, oscillating type. | 6 |
| **Humidity and Moisture Measurement** | Humidity measurement – dry and wet psychrometer, hair hygrometer, resistance element type, saturated-salt dew-point sensor, electrolytic hygrometer, aluminium oxide sensor, quartz crystal type. Moisture measurement - thermal drying, distillation method, chemical reaction methods, electrical methods. | 6 |
| **Non - Electrical Methods of Pressure Measurement** | Different types of pressure measurement, units of pressure, manometers, elastic type of pressure gauges, bellows, diaphragms and Bourdon tubes, bell type and slack diaphragm pressure gauges. Selection of pressure gauges - testing & calibration of pressure gauges, dead weight tester, installation and maintenance of pressure gauges, differential pressure transmitters. Electrical methods of pressure measurement - pressure gauges using strain gauges, capacitive, inductive and piezo – electric. | 10 |
| **Methods of Temperature Measurements** | Temperature scales, filled-in system, liquid filled, gas filled, vapour pressure thermometer, sources of errors, compensation techniques, bimetallic thermometers. Electrical methods of temperature measurement - RTDs, industrial construction, 3/4 wire RTDs, improved bridge circuits,. Thermistors - features, construction, linearize circuits, specific applications. Thermocouples - working & construction, types of thermocouples, laws of thermocouples, cold junction, compensation methods. ICs for temperature measurements - AD590, AD 540. Pyrometers & miscellanies - basic principles, radiation pyrometer, thermal detectors, pyroelectric detectors, optical pyrometers, selection of temperature sensors. | 11 |

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|---|---|---|
| **Flow Measurement** | D. P. flow meters - physical properties of flow, fundamentals of flow measurements, differential pressure flow meters - operating principle, different types, orifice, Venturi meter, pitot tube. Mechanical type flow meters - principle of operation, element of construction and application of positive displacement meters, inferential flow meter, rotameters, turbine flow meters, target flow meter. Electrical type flow meters - principle of operation, construction, applications, of electromagnetic flow meters, ultrasonic flow meters, cross correlation flow meters, vortex shedding flow meters. Mass flow meters & open channel flow measurement - conventional methods, Coriolis flow meters, angular momentum, Weirs, Flumes, guidelines for flow meters selections, calibration of flow meters. | 12 |
| | **Total No. of Hours** | **45** |
| **Textbooks** | 1. Doebelin E.O, "Measurement Systems: Application and Design", McGraw Hill.<br>2. Patranabis D, "Principles of Industrial Instrumentation", Tata McGraw Hill.<br>3. Holman, P., "Experimental Methods for Engineers", 6th Edition, McGraw – Hill Book Coy. | |
| **References** | 1. Douglas M. Considine, "Process / Industrial Instruments & Controls Handbook", McGraw Hill.<br>2. Eckman, D.P., "Industrial Instrumentation", Wiley Eastern Limited.<br>3. A. K. Sswhney, "Mechanical Measurements and Instrumentation", Dhanpat Rai & co. | |

| **SET/EI/BT/C504. POWER ELECTRONICS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Characteristics of Power Devices** | Introduction, Characteristics of Diodes, SCRs, GTO, BJT, MOSFET, IGBT, LASCR, two transistors model of SCR, protection of thyristors against over voltage and over current. | 6 |
| **Converters** | AC-DC Converters - single phase, half wave and full wave: uncontrolled, semi controlled and fully controlled rectifiers: single-phase and three-phase: waveforms of load voltage and line current under constant load current, their simulation, AC-AC converters: AC voltage controllers and cycloconverters, Non-isolated DC-DC converters: Buck, Boost, Buck-boost & Cuk, their simulation , Isolated DC-DC converters, their simulation. | 16 |
| **Inverters** | Line commutated and forced commutated inverters, DC-AC Inverters: Single-phase and three-phase, modulation techniques, Current Source inverter. | 10 |
| **Applications** | Application of power electronics in Generation, Transmission, Distribution of electricity. | 8 |
| | **Total No. of Hours** | **40** |
| **Textbooks** | 1. P.S.Bhimra, Power Electronics. Khanna Publication, Delhi.<br>2. M.H. Rashid, Power Electronics. P.H.I Private Ltd. New Delhi, | |
| **References** | 1. N. Mohan, T.M. Undeland & W.P. Robbins, Power Electronics. John Wiley & Sons, Inc, 2003.<br>2. M.D. singh & K.B. Khanchandani, power electronics. Tata McGraw-Hill Education. | |

| **SET/EI/BT/C504MOOC. POWER ELECTRONICS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Introduction to Power Electronics, Power devices: Diodes, SCRs, GTO, BJT, MOSFET, IGBT- Characteristics, working, selection and protection, AC-DC converter: half wave & full wave; uncontrolled, semi-controlled & fully controlled; single-phase and three-phase. | 12 |
| **Week 4-6** | Assignment No. 2 and 3 on single-phase and three-phase converters and simulations, AC-AC converters: AC voltage controllers and cycloconverters, Non-isolated DC-DC converters: Buck, Boost, Buck-boost & Cuk. | 12 |
| **Week 7-9** | Isolated DC-DC converters, DC-AC Inverters: Single-phase and three-phase, modulation techniques, Current Source inverter. | 12 |
| **Week 10-12** | Applications of Power Electronics in Generation, Transmission, Distribution & utilization sectors, Assignment No. 6 on Isolated DC-DC converters: Problems and simulation, Assignment No. 7&8 on DC-AC inverters (single-phase and three-phase): problems and simulation. | 12 |
| | **Total No. of Hours** | **48** |
| **Textbooks** | 1. P.S.Bhimra, Power Electronics. Khanna Publication, Delhi.<br>2. M.H. Rashid, Power Electronics. P.H.I Private Ltd. New Delhi, | |
| **References** | 1. N. Mohan, T.M. Undeland & W.P. Robbins, Power Electronics. John Wiley & Sons, Inc, 2003.<br>2. M.D. singh & K.B. Khanchandani, power electronics. Tata McGraw-Hill Education. | |

| SET/EI/BT/E505 (i). ELECTRICAL DRIVES | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **DC motor characteristics** | Introduction to Electrical Drives; Dynamics of Electrical Drives; Review of Torque-Speed Characteristics of DC Motors (Shunt and Series) including Motoring and Braking. | 5 |
| **Converter fed DC drive** | Converter (Half Controlled Converter, Full Controlled Converter, Dual Converters); Control of DC Motor Drives; Torque Speed Characteristics of Converter-fed DC Drives. | 5 |
| **Choper controlled DC motor** | Chopper Controlled DC Drives (Single and Multi-quadrant Converters), Motoring and Braking operations. | 5 |
| **Induction motor drives** | Induction Motor Drives – Equivalent circuits; Torque-speed characteristics; Operation of Induction Motor with Unbalanced Source Voltages; Analysis of Induction Motor from Non-sinusoidal Voltage Supply; Starting and Braking of Induction Motor. | 6 |
| **Induction motor control** | Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, Stator Voltage Control of Induction Motor; Variable Voltage/ Current; Variable Frequency Control of Induction Motor Fed from VSI and CSI; Control of Slip-ring Induction Motor. | 8 |
| **Synchronous motor drives** | Synchronous Motor Characteristics (Cylindrical and Salient Pole); CSI-fed Synchronous Motor Drive; Permanent Magnet Synchronous Motor Drive; Brushless DC Motor Drives | 5 |
| **Traction drives** | Traction Drives – Characteristics of Traction Drives; Drive Power Requirement; DC and AC Traction. | 5 |
| **Switched Reluctance and stepper Motor** | Switched Reluctance Motor – Construction; Analysis and Closed-loop Control; Various Types of Stepper Motor and their Characteristics. | 5 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, 1989. | |
| **References** | 2. R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall, 2001.<br>3. G. K. Dubey, "Fundamentals of Electrical Drives", CRC Press, 2002.<br>4. W. Leonhard, "Control of Electric Drives", Springer Science & Business Media, 2001. | |

| SET/EI/BT/E505 (ii). LINE COMMUTATED AND ACTIVE PWM RECTIFIERS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Diode rectifiers with passive filtering** | Single phase half wave diode rectifier with R and RL load, Single phase half wave diode rectifier with RC load, input current wave shape, Single phase full wave diode rectifier with R ,RL and RC load, Performance parameter of single phase full wave diode rectifier, continuous and discontinuous conduction, Three phase diode rectifier, Effect of source inductance, commutation overlap. | 6 |
| **Thyristor rectifiers with passive filtering** | Half-wave thyristor rectifier with R and RL loads; 1-phase thyristor rectifier with R and RL load, thyristor rectifier in inverting mode, Rectification and regenerating modes, performance parameter of half wave and full wave converter. | 8 |
| **Multi-Pulse converter** | Three phase thyristor rectifier, output voltage equation of three phase rectifiers, Review of transformer phase shifting, 6- pulse converters with inductive loads, 12-pulse converters with inductive loads, output voltage equation. | 6 |
| **Pulse Width Modulated rectifier** | Power factor improvement of controlled rectifier, Concept of Pulse width modulated rectifier, power circuit of single-switch ac-dc converter, Single phase sinusoidal pulse width modulation, Three phase PWM rectifier, Three phase sinusoidal pulse width modulation. | 6 |
| **DC to AC converter** | Review of 1-phase inverter, power circuits of 1-phase dc to ac converter, Review of 3-phase inverter, power circuits of 3-phase dc to ac converter, Pulse Width Modulated inverter, Single pulse width modulation, Multiple pulse width modulation, Three phase PWM rectifier. | 8 |
| **Isolated single phase dc-dc converter** | Review of DC to DC converters: Buck and Boost converter, Review of DC to DC converters: BuckBoost and Cuck converter, Review of linear power supplies, Advantages of SMPS over linear power supplies, dc-dc flyback converter, output voltage as a function of duty ratio and transformer turns ratio, Power circuit of dc-dc forward converter, push pull converter. | 10 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988. | |

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|---|---|
| **References** | 1. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison-Wesley, 1991.<br>2. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.<br>3. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design",John Wiley & Sons, 2007.<br>4. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2001. |

| **SET/EI/BT/E505 (iii). ELECTRICAL MACHINE DESIGN** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines. | 8 |
| **Transformers** | Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers. | 8 |
| **Induction Motors** | Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics. | 10 |
| **Synchronous Machines** | Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design. | 9 |
| **Computer aided Design (CAD)** | Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to **c**omplex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines. | 8 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970. | |
| **References** | 2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.<br>3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.<br>4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 1969.<br>5. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.<br>6. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.<br>7. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package. | |

| **SET/EI/BT/C506. POWER SYSTEMS LAB** | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Testing of the earth fault ralay.<br>2. Testing of the transformer oil.<br>3. To demonstrate the power factor.<br>4. Transmission line trainer system.<br>5. Load flow/voltage drop, short circuit, optimal power flow, stability etc. analysis with the help of ETAP software. | 14x2 |
| **Total No. of Hours** | **28** |

| **SET/EI/BT/C507. CONTROL SYSTEMS LAB** | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. To determine response of first order and second order systems for step input for various values of constant "K" using linear simulator unit and compare theoretical and practical results.<br>2. To study P, PI and PID temperature controller for an oven and compare their performance.<br>3. To study and calibrate temperature using resistance temperature detector (RTD).<br>4. To design Lag, Lead and Lag-Lead compensators using Bode plot.<br>5. To study behavior of separately excited dc motor in open loop and closed loop conditions at various loads.<br>6. Related Simulations using MATLAB. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/EI/BT/C508. INDUSTRIAL INSTRUMENTATION LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Determination of Discharge coefficient of Orifice plate and Venturi meter.<br>2. Measurement of flow rate using Orifice, Venturimeter, Flow nozzle and Rotameter.<br>3. Verification of Bernoulli Theorem.<br>4. Pressure gauge calibration using Dead Weight Tester.<br>5. Temperature measurement using RTD, Thermistors.<br>6. Viscosity Measurement using Falling Sphere Method. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/EI/BT/C509. POWER ELECTRONICS LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Characteristics of SCR, DIAC and TRIAC.<br>2. SCR control for AC and DC loads.<br>3. Series inverter using SCR.<br>4. Fan regulator using DIAC and TRIAC.<br>5. Parallel inverter using SCR.<br>6. AC phase control using SCR.<br>7. Study of phase splitter.<br>8. Commutative circuits. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/HS/BT/H510. FOUNDATIONS OF YOGA | | |
|---|---|---|
| **Module** | **Content** | **No. of Hrs.** |
| **General Introduction to Yoga** | Brief about origin of Yoga: Psychological aspects and Mythological concepts; History and Development of Yoga: prior to the Vedic period, Vedic period, Medival period, modern era; Etymology and Definitions of Yoga, Aim and Objectives of Yoga, Misconceptions of Yoga; Brief about Streams of Yoga; Principles of Yoga, Importance of Yoga. Ashtang Yoga. | 8 |
| **General Introduction to Indian Philosophy** | Philosophy: meaning, definitions and scope; Indian Philosophy: Salient features, Branches (Astika and Nastika Darshanas), Distinction from Religion and Science, Brief introduction to Prasthanatrayee and Purushartha Chatushtaya; Relationship between Yoga and Indian Philosophy. | 8 |
| **Brief about Yoga in texts – I** | Brief to Upanishads and Yoga in Principal Upanishads, Yoga in Yogopanishad; Yogic perspective of Epics: Ramayana and Mahabharata; Yogic perspective: Bhagavad Gita, Yoga Vasishtha. | 8 |
| **Brief about Yoga in texts – II** | Yogic perspective: Smritis, Puranas with emphasis to Bhagavat Purana; Yogic perspective to Shad-darshanas; Brief: Agamas, Tantras, Shaiva Siddhanta. | 8 |
| | **Total** | **32** |
| **Textbooks** | 1. Lal Basant Kumar : Contemporary Indian Philosophy, Motilal Banarsidas Publishers Pvt. Ltd, Delhi, 2013<br>2. Dasgupta S. N : History of Indian Philosophy, Motilal Banarsidas, Delhi, 2012<br>3. Singh S. P : History of Yoga, PHISPC, Centre for Studies in Civilization Ist, 2010<br>4. Singh S. P & Yogi Mukesh : Foundation of Yoga, Standard Publication, New Delhi, 2010 | |
| **References** | 1. Agarwal M M : Six systems of Indian Philosophy, Chowkhambha Vidya Bhawan, varanai, 2010<br>2. Swami Bhuteshananda : Nararad Bhakti Sutra, Advaita Ashrama Publication-Dept. Kolkata, II Edition, 2009<br>3. Hiriyanna M : Outlines of Indian Philosophy, Motilal Banarsidas, Delhi, 2009<br>4. Hiriyanna M: Essentials of Indian Philosophy, Motilal Banarsidas, Delhi, 2008<br>5. Radhakrishnan S: Indian Philosophy, Oxford University, UK (Vol. I & II) II Edition, 2008<br>6. Max Muller K. M : The six system of Indian Philosophy, Chukhambha, Sanskrit series, Varanasi, 6th Edition, 2008 | |

**SEMESTER VI**

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/EC/BT/C601 | Digital Signal Processing | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/EI/BT/C602 | PLC and Automation | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 3 | SET/EI/BT/C603 | Process Control | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 4 | | PE-02 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | | PE-02MOOC | - | - | - | - | - | - | - | | |
| 5 | | OE-01 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 6 | SET/EI/BT/C606 | PLC and Automation Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 7 | SET/EI/BT/C607 | Process Control Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 8 | SET/EI/BT/C608 | Seminar | - | - | - | - | - | - | 100 | 100 | 1 |
| 9 | SET/SH/BT/A609 | Biology (*HSMC) | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | | | | | | | | | | **Total** | 21 |

* Humanities and Social Sciences including Management courses.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 02 (PE-02)** | 1 | SET/EI/BT/E604 (i) | HVDC Transmission Systems |
| | 2 | SET/EI/BT/E604 (ii) | Electrical machines-II |
| | | SET/EI/BT/E604 (ii)MOOC | Electrical machines-II** |
| | 3 | SET/EI/BT/E604 (iii) | Embedded Systems |
| | | SET/EI/BT/E604 (iii)MOOC | Embedded Systems** |

**MOOC Course

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Open Elective 01 (OE-01)** | 1 | SET/EI/BT/E605 (i) | Power Plant Engineering |
| | 2 | SET/EI/BT/E605 (ii) | Optical Instrumentation |
| | 3 | SET/EI/BT/E605 (iii) | Principles of Communication Systems |

| **SET/EC/BT/C601. DIGITAL SIGNAL PROCESSING** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Discrete Time Signals and Systems** | Discrete time signals, discrete systems, difference equations, Discrete time Fourier transform (DTFT), Properties of DTFT, frequency domain representation of LTI systems, Sampling and reconstruction of analog signals. | 4 |
| **Z- Transforms** | Bilateral z-transform, important properties of the z-transforms, inverse z-transform, system representation in the z-domain, Implementation of discrete time systems, solution of the difference equations. | 6 |
| **Discrete Fourier Transform** | Discrete Fourier transform, properties of the discrete Fourier transform, linear & circular convolution using DFT, Fast Fourier Transform algorithm, inverse DFT using FFT algorithm. | 10 |
| **Digital Filter Structures** | Characteristics of prototype analog filters, analog-to-digital filter transformations, Basic elements, IIR filter structure, FIR filter structure, lattice filter structures. | 10 |
| **Filter Design** | Design of IIR & FIR filters; Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters, properties of linear-phase FIR filters, window design techniques, Park-McClellan's method. | 12 |
| | **Total No. of Hours** | **42** |
| **References** | 1. A. Shalivahan, Digital Signal Processing; TMH.<br>2. A.V. Oppenheim & R.W. Schafer; Digital Signal Processing, Prentice Hall.<br>3. L.R. Rabiner & B. Gold; Theory and Applications of Digital Signal Processing, PHI.<br>4. A. Antoniou; Introduction of Digital Filters.<br>5. C. Emmanuel Ifeachor & W. Jervis Barrie; Digital Signal Processing, A Practical Approach.<br>6. Vinay K. Ingle & John G. Proakis ; Digital Signal Processing. | |

| SET/EI/BT/C602. PLC AND AUTOMATION | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | About PLC, History of PLC, Introduction of PLC in manufacturing unit, PLC versus computer, Basic PLC components, Basic operation of PLC system, SCADA System and DCS. | 5 |
| **PLC Hardware** | PLC hardware components- input/output modules, Processors, Power supply, Programming devices, Memory organization- AB memory organization, Logical addressing. | 8 |
| **PLC Programming** | Ladder logic diagram, Implementation of Logic gates and Boolean expressions using LLD, Seal-in Circuit, Instructions of ladder programming-relay type instruction, Program control instructions, Data Manipulation Instructions, Math Instructions. | 10 |
| **Timers and counters** | Introduction to timers and counters, Types of timers and counters, Timers and counters programming, PLC sequencer and shift registers-sequencer, synchronous and asynchronous shift register, sequencer instruction. | 14 |
| **PLC communication** | Types of communication- serial communication, industrial communication network, industrial I/O networks, different type of network communication protocol**.** | 7 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. W Bolton, "Programmable Logic Controllers". Elsevier publications.<br>2. Krishna Kant, "Computer-based Industrial Control", Prentice Hall. | |
| **References** | 1. John.W. Webb Ronald A Reis, "Programmable Logic Controllers - Principles and Applications", Prentice Hall.<br>2. Lukcas M.P, "Distributed Control Systems", Van Nostrand Reinhold Co.<br>3. Frank D. Petruzella, "Programmable Logic Controllers", McGraw Hill.<br>4. Curtis D. Johnson, "Process Control Instrumentation Technology", Prentice Hall. | |

| SET/EI/BT/C603. PROCESS CONTROL | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Process Dynamics** | Process variables, load variables, dynamics of simple pressure, flow level and temperature processes, interacting and non-interacting systems, continuous and batch process, self-regulation, servo and regulator operation, problems. | 10 |
| **Controllers and Tuning** | Basic control actions, characteristics of two position, three position, proportional, single speed floating, integral and derivative control modes, on - off, P, P+I, P+D and P+I+D control modes, problems, pneumatic, hydraulic and electronic controllers to realize various control actions. Optimum controller settings*:* Evaluation criteria, $1/4^{th}$ decay ratio, IAE, ISE, ITAE determination of optimum settings for mathematically described process using time response and frequency response, Process reaction curve method, continuous oscillation method, damped oscillation method, problems. | 14 |
| **Final control element** | I/P converter, pneumatic, electric and hydraulic actuators, valve positioner, control valves, characteristics of control valves, valve body, globe, butterfly, diaphragm, ball valves, control valve sizing, cavitations, flashing problem. | 10 |
| **Multi loop Control System** | Feed forward control, ratio control, cascade control, split range, multivariable control and examples from distillation column & boiler system. | 10 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Wayne Bequette, "Process Control – Modeling, Design and Simulation", Prentice Hall.<br>2. Stephanopoulos, "Chemical Process Control, 2nd edition, Prentice Hall.<br>3. Coughanowr, "Process Systems Analysis and Control", McGraw Hill.<br>4. Peter Harriott, "Process Control", Tata McGraw Hill. | |
| **References** | 1. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., "Process Dynamics and Control", Wiley.<br>2. Smith C.L and Corripio.A..B, "Principles and Practice of Automatic Process Control", Wiley.<br>3. Shinskey, "Process Control Systems", 4th Edition, McGraw Hill.<br>4. Paul W.Murril, "Fundamentals of Process Control Theory", ISA press.<br>5. M.Chidambaram, "Applied Process Control", Allied Publishers.<br>6. Deshpande P.B and Ash R.H, "Elements of Process Control Applications", ISA Press.<br>7. Curtis D. Johnson, "Process Control Instrumentation Technology", Prentice Hall.<br>8. D. P. Eckman, "Automatic Process Control".<br>9. Pollard, "Process Control", Heinemann Educational Books. | |

| SET/EI/BT/E604 (i). HVDC TRANSMISSION SYSTEMS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Module 1** | Evolution of HVDC Transmission. Comparison of HVAC and HVDC systems. Type of HVDC Transmission systems. Components of HVDC transmission systems. | 8 |
| **Module 2** | Analysis of simple rectifier circuits. Required features of rectification circuits for HVDC transmission. Analysis of HVDC converter. Different modes of converter operation. Output voltage waveforms and DC voltage in rectification. Output voltage waveforms and DC in inverter | 8 |

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|---|---|---|
| | operation. Thyristor voltage .Equivalent electrical circuit. | |
| **Module 3** | HVDC system control features. Control Modes. Control Schemes. Control comparisons. | 6 |
| **Module 4** | Converter mal-operations. Commutation failure. Starting and shutting down the converter bridge. Converter protection. | 6 |
| **Module 5** | Smoothing reactor and DC Lines. Reactive power requirements. Harmonic analysis. Filter design. | 6 |
| **Module 6** | Component Models for the Analysis of AC DC Systems. Power flow analysis of AC-DC systems. Transient stability analysis. Dynamic stability analysis. | 6 |
| **Module 7** | Multi-terminal HVDC system. Advances in HVDC transmission. HVDC system application in wind power generation. | 4 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. KR Padiyar, "HVDC Power Transmission Systems", Willey Eastern Limited, Second edition. | |
| **References** | 2. J Arrillaga, "High Voltage Direct current Transmission", Peter Peregrinus Ltd, UK.<br>3. EW Kimbark, "Direct Current Transmission", Wiley-Interscience, New York.<br>4. SN Singh, "Electric Power Generation, Transmission and Distribution, PHI, New Delhi 2nd edition, 2008. | |

| **SET/EI/BT/E604 (ii). ELECTRICAL MACHINES –II** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Transformer** | Brief review of transformer. Rotating machine: general constructional features. Conditions for steady production of electromagnetic torque. Torque production can be explained in terms of interaction of two sets of magnetic poles – one produced by stator coil current and the other by rotor coil currents.<br>MMF and flux density distribution along the air-gap of a rotating machine by a single coil and by multiple coils. Basic winding terms and elementary balanced 3-phase winding. Idea of electrical and mechanical angle.<br>Production of rotating field by a 3-phase winding – its speed and direction of rotation and its far reaching implications. | 10 |
| **3-phase induction motor** | The expression of induced voltage in a coil when it moves relative to a field distribution – its rms value and frequency.<br>Types and constructional features of 3-phase induction motor. Slip and its importance. Development of equivalent circuit of the motor when it runs with a slip. Getting expression for torque in terms of equivalent circuit parameters and supply voltage.<br>Typical torque slip characteristic. Fixing operating point when load torque is present. Modification of the torque -slip characteristic by varying rotor resistance, supply voltage and frequency. | 10 |
| **Single phase induction motor and Synchronous machine** | Estimation of equivalent circuit parameters from no load and locked (blocked) rotor tests. Problem solving.<br>Single phase induction motor: double revolving eld theory and development of equivalent circuit and expression for torque.. Torque-slip characteristic. Expression for starting torque in presence of auxiliary winding. Estimation of starting capacitance for auxiliary coil using concept of phase splitting<br>Synchronous machine: Types and constructional features. EMF equation and concept of synchronous reactance. Synchronizing an incoming generator (alternator) to the bus. Phasor diagram as generator. Regulation. Effect of excitation variation when generator is connected to bus. Power-angle characteristic.<br>Steady state stability limit. | 10 |
| **Operating conditions and Phasor diagrams** | Synchronous machine connected to bus and operating as motor. Phasor diagram under various operating conditions. Effect of excitation variation.<br>Salient pole synchronous machine: concept of direct axis and Quadrature axis reactance's. Phasor diagrams under various operating conditions both for motoring and generating mode.<br>Swing equation under dynamic condition. Equal area criteria. Steady state and transient stability limits. | 10 |
| | **Total No. of Hours** | **40** |
| **Text books and references** | 1.Electric Machinery Fundamentals 4th Edition by Stephen Chapman<br>2. Electrical Machinery 7th Edition P. S. Bimbhra<br>3. Electric Machines and Power System by Del Toro. | |

| SET/EI/BT/E604 (ii)MOOC. ELECTRICAL MACHINES –II | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Brief review of transformer. Rotating machine: general constructional features. Conditions for steady production of electromagnetic torque. Torque production can be explained in terms of interaction of two sets of magnetic poles – one produced by stator coil current and the other by rotor coil currents, MMF and flux density distribution along the air-gap of a rotating machine by a single coil and by multiple coils. Basic winding terms and elementary balanced 3-phase winding. Idea of electrical and mechanical angle, Production of rotating field by a 3-phase winding – its speed and direction of rotation and its far reaching implications. | 10 |
| **Week 4-7** | The expression of induced voltage in a coil when it moves relative to a field distribution – its rms value and frequency, Types and constructional features of 3-phase induction motor. Slip and its importance. Development of equivalent circuit of the motor when it runs with a slip. Getting expression for torque in terms of equivalent circuit parameters and supply voltage.<br>Typical torque slip characteristic. Fixing operating point when load torque is present. Modification of the torque -slip characteristic by varying rotor resistance, supply voltage and frequency. | 10 |
| **Week 8-10** | Estimation of equivalent circuit parameters from no load and locked (blocked) rotor tests. Problem solving, Single phase induction motor: double revolving eld theory and development of equivalent circuit and expression for torque.. Torque-slip characteristic. Expression for starting torque in presence of auxiliary winding. Estimation of starting capacitance for auxiliary coil using concept of phase splitting, Synchronous machine: Types and constructional features. EMF equation and concept of synchronous reactance. Synchronizing an incoming generator (alternator) to the bus. Phasor diagram as generator. Regulation. Effect of excitation variation when generator is connected to bus. Power-angle characteristic, Steady state stability limit. | 10 |
| **Week 10-12** | Synchronous machine connected to bus and operating as motor. Phasor diagram under various operating conditions. Effect of excitation variation, Salient pole synchronous machine: concept of direct axis and Quadrature axis reactances. Phasor diagrams under various operating conditions both for motoring and generating mode, Swing equation under dynamic condition. Equal area criteria. Steady state and transient stability limits. | 10 |
| | **Total No. of Hours** | **40** |
| **Text books and references** | 1.Electric Machinery Fundamentals 4th Edition by Stephen Chapman<br>2. Electrical Machinery 7th Edition P. S. Bimbhra<br>3. Electric Machines and Power System by Del Toro. | |

| SET/EI/BT/E604 (iii). EMBEDDED SYSTEMS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to Embedded Systems** | Introduction to Embedded Systems and Computer Systems Terminology. Modular approach to Embedded System Design using Six-Box model: Input devices, output devices, embedded computer, communication block, host and storage elements and power supply.<br>Microcontroller Based Embedded System Design. Salient Features of Modern Microcontrollers. Elements of Microcontroller Ecosystem and their significance.<br>Design of Power Supply for Embedded Systems. Linear Regulator Topologies. Switching Power Supply Topologies. Power Supply Design Considerations for Embedded Systems. | 10 |
| **Introduction to MSP430** | Introduction to MSP430 Microcontroller. MSP430 CPU Architecture. Programming Methods for MSP430. Introduction to Lunchbox Platform.<br>Fundamentals of Physical Interfacing. Connecting Input Devices: Switches, Keyboard and Output devices: LEDs, Seven Segment Displays (SSD). Assignment: MCQ/MSQ<br>Advanced Physical Interfacing: Driving load - high side, low side and H-bridge. Multiplexing displays including Charlieplexing. Shaft encoder. | 10 |
| **Programming the MSP430** | Programming the MSP430. Basics of version control system - Git. Installing and using Code Composer Studio (CCS). Introduction to Embedded C. Interfacing LEDs and Switches with MSP430 using Digital Input and Output.<br>MSP430 Clock and Reset System. MSP430 Clock sources and distribution. Types of Reset sources. Handling Interrupts in MSP430. Writing efficient Interrupt Service Routine (ISR).<br>Interfacing Seven Segment Displays and Liquid Crystal Displays with MSP430. Low Power Modes in MSP430. Introduction to MSP430 Timer Module and it's Modes of Operation. | 10 |
| **(PWM) using Timer Capture Mode, Timer Capture Modes and Prototyping techniques** | Generating Pulse Width Modulation (PWM) using Timer Capture Mode. ADC operation in MSP430. Interfacing analog inputs. Generating random numbers using LFSR and other methods. Adding DAC to MSP430. Custom Waveform generation using MSP430.<br>Timer Capture Modes. Measuring frequency and time period of external signals and events. Serial Communication Protocols: UART, SPI, I2C. Interfacing Universal Serial Communication Interface (USCI) Module of the MSP430 for UART Communication. Advanced Coding Exercises based on Interrupt driven Programming. Building an Electronics Project.<br>Circuit Prototyping techniques. Designing Single Purpose Computers using Finite State Machine with Datapath (FSMD) approach. MSP430 Based Project Design and Implementation. Recap of Course Coverage. | 10 |

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| | **Total No. of Hours** | **40** |
| **Text books and references** | 1.Electric Machinery Fundamentals 4th Edition by Stephen Chapman<br>2. Electrical Machinery 7th Edition P. S. Bimbhra<br>3. Electric Machines and Power System by Del Toro. | |

| **SET/EI/BT/E604 (iii)MOOC. EMBEDDED SYSTEMS DESIGN** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Introducton to Embedded System, ASICs and ASIPs. Designing Single Purpose Processors and Optmizaton, Introducton to FPGAs and Synthesis, | 10 |
| **Week 4-6** | Verilog Hardware Descripton Language (Verilog HDL), Microcontrollers and Power Aware Embedded System Design, Real Time Operatng System, | 10 |
| **Week 7-9** | Real Time Scheduling Algorithms, Modelling and Specifcaton, Design Synthesis, | 10 |
| **Week 10-12** | Digital Camera Design and Hardware Sofware Parttoning, Design Optmizaton, Simulaton and Verifcaton | 10 |
| | **Total No. of Hours** | **40** |
| **Text books and references** | 1. Designing Embedded Hardware, John Catsoulis. 2nd edition. Shroff Publishers and Distributors. ISBN-10: 9788184042597.<br>2. Embedded System Design: A Unified Hardware / Software Introduction. Tony Givargis and Frank Vahid. Wiley. ISBN-10: 812650837X.<br>3. MSP430 Microcontroller Basics. John H. Davies. Elsevier. ISBN-10: 9789380501857. Programming Embedded Systems in C and C++. Micheal Barr. Shroff Publishers and Distributors. ISBN-10: 817366076X. | |

| **SET/EI/BT/E605 (i). POWER PLANT ENGINEERING** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to Conventional energy Sources** | Steam, hydro, nuclear, diesel and gas, their scope and potentialities for energy conversion. Different factors connected with a generating station, load curve, load duration curve, energy load curve, base load and peak load plants. | 6 |
| **Thermal power generation** | Selection of site, size and no. of units, general layout, major parts, auxiliaries, generation costs of steam stations. | 6 |
| **Hydro power generation** | Selection of site, mass curve, flow duration curve, hydrograph, classification of hydro plants, types of hydro turbines, pumped storage plants. | 6 |
| **Nuclear power generation** | Main parts, location, principle of nuclear energy, types of nuclear reactors, reactor control, nuclear waste disposal. | 6 |
| **Power station control and interconnection** | Excitation systems and their types, excitation control, automatic voltage regulator action, interconnection of different power stations and their advantages. | 7 |
| **Economic operation of power system** | Introduction, distribution of load between units within the plant. Optimum generation scheduling considering transmission losses. | 5 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. Sam. G. Dukelow, "The Control of Boilers", 2nd Edition, ISA Press.<br>2. Gill A.B, "Power Plant Performance", Butterworth.<br>3. P.C Martin, I.W Hannah, "Modern Power Station Practice", British Electricity International Vol. 1 & VI, Pergamon Press, London, 1992. | |
| **References** | 1. David Lindsley, "Boiler Control Systems", McGraw Hill, New York, 1991.<br>2. Jervis M.J, "Power Station Instrumentation", Butterworth Heinemann, Oxford, 1993.<br>3. Modern Power Station Practice, Vol.6, "Instrumentation, Controls and Testing", Pergamon Press, Oxford, 1971. | |

| **SET/EI/BT/E605 (ii). OPTICAL INSTRUMENTATION** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Fabrication of optical components** | Optical materials- properties; optical components- optical flats, wedges, mirrors, lenses, prisms, grating, compensating plates; Optical machining tools- abrasive materials, drilling, trepanning, curve generating tools. Making flats, mirrors, lenses, prisms: cutting, grinding, smoothing, surfacing, and polishing of glasses and crystals. | 6 |
| **Testing of optical components** | Refractive index measurement- glass slab, prism, Abbe's spectrometer; Wedge measurement- autocollimator, Fizeau interferometer, Measure of radius of curvature- Spherometer mothod, Newton's ring method, Rochi - grating test, Foucault-Knife edge test. Measure of flatness and surface accuracy- Principle and construction of Newton's, Fizeau, Twyman - Green interferroscope. Mach - Jehender, Michelson, Fabry - Perrot interferometer, distance measuring | 9 |

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| | interferometer. | |
| **Optical fibre** | Introduction to optical fibers, light guidance, acceptance angle, numerical aperture, different types of fibers, fiber losses, dispersion, manufacturing techniques, cabling, splicing, connectorization, light sources and detectors, noise, optical fibers for communication, optical fibers for instrumentation. Fiber optic sensors: Interferometer method of measurement of length, measurement of pressure, temperature, current, voltage, liquid level and strain. | 10 |
| **Lasers** | Theory of lasing action, Einstein's coefficients; He-Ne, $CO_2$ lasers, Q-switching, electro-optic, magneto-optic and acousto-optic modulators. | 10 |
| **Holography** | Theory and construction of holograms, holography and holographic interferometry, application to measurement and various physical parameters and properties. | 8 |
| | **Total No. of Hours** | **43** |
| **References** | 1. R. Hradayanath, "Optical Workshop Technology, TMH publications.<br>2. M. Silfvast, "Fundamentals of Laser", Cambridge University Press, 1996.<br>3. K. Thaigarajan & A. K. Ghatak, "Lasers: Theory and Applications".<br>4. P. Das, "Lasers and Optical Engineering". Springer.<br>5. A. K. Ghatak & K. Thaigarajan, "Optical Electronics Foundation Books".<br>6. A. Yariv, "Introduction to Optical Electronics". Holt, Rinehart and Winston, 1971.<br>7. G. P. Agrawal, "Fibre Optic Communication Systems". (Wiley Series in Microwave and Optical Engineering.<br>8. G. Keiser, "Optical Fibre Communication". McGraw-Hill. | |

| **SET/EI/BT/E605 (iii). PRINCIPLES OF COMMUNICATION SYSTEMS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Introduction to communication systems; Amplitude Modulation, switching modulator, envelop detector, limitations and modification of Amplitude modulation, DSB-SC, ring modulator, coherent detection, Costas receiver, Quadrature carrier multiplexing, single sideband modulation, VSB modulation, frequency translation, FDM. | 9 |
| **Phase and Frequency modulation** | Phase and Frequency modulation: basics, properties of angle modulated waves, FM, narrow band FM, phase noise, wide-band FM, transmission bandwidth of FM signals, generation and demodulation of FM signals, PLL, nonlinear effects in FM systems, The Super-heterodyne receiver. | 9 |
| **Random variable and processes** | Random variable and processes: statistical averages, mean, correlation, covariance functions, power spectral density, Gaussian process, noise: Noise in DSB-SC, AM and FM receivers; pre-emphasis and de-emphasis in FM systems. | 9 |
| **Sampling and Quantization** | Sampling, PAM, TDM, PPM, generation and detection of PPM waves, Quantization process and noise, PCM, encoding, line codes, differential encoding, regenerative repeater, T1 system; Delta modulation, Delta Sigma modulation. | 9 |
| **Transmission of digital signals** | Base-band transmission of digital signals, Band-pass transmission of digital signals, Basics of information theory and forward error correction. | 6 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. 1. Simon Haykin, Michael Moher, "Communication System", 5th Ed., Wiley.<br>2. B P Lathi, "Communication Systems". | |
| **References** | 1. Taub, Schilling, "Principles of Communication Systems", TMH.<br>3. Singh, R.P. and Sapre, S.D., "Analog and Digital Communication Systems",TMH. | |

| **SET/EI/BT/C606. PLC AND AUTOMATION LAB** | |
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| **Content** | **No. of Hrs.** |
| Related experiments on demonstration kits and Ladder Logic Programming using simulation software. | 15x2 |
| **Total No. of Hours** | **30** |

| **SET/EI/BT/C607. PROCESS CONTROL LAB** | | |
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| **Module** | **Content** | **No. of Hrs.** |
| **Module 1** | 1. Study of Process Control Training Plant and Compact Flow Control Unit.<br>2. Level Control and Pressure Control in Process Control Training Plant.<br>3. Study and Demonstration of Closed loop system with Disturbance.<br>4. Study and demonstration of ON/OFF, P, PI, PD and PID Controllers.<br>5. Tuning of PID Controller for mathematically described processes.<br>6. Study of complex control systems (Ratio, Feed forward, and Cascade). | 14x2 |
| | **Total No. of Hours** | **28** |

| **SET/EI/BT/C608. SEMINAR** | |
|---|---|
| **Content** | **No. of Hrs.** |
| Every Student shall deliver a seminar for 30 minutes. Topic for the seminar shall be decided in consultation with faculty. Topic can be related to an application or a technology which makes use of Electrical and Instrumentation | 14x2 |

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| engineering. Students should search for the related literature and prepare a presentation. Evaluation shall be based on content, presentation and active participation. | |
| **Total No. of Hours** | **28** |

| **SET/SH/BT/A609. BIOLOGY** | | |
|---|---|---|
| **Module** | **Content** | **No. of Hrs.** |
| **Introduction** | Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. need to study biology, Brownian motion and the origin of thermodynamics. | 3 |
| **Classification** | Hierarchy of life forms at phenomenological level, classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (f) Molecular taxonomy- three major kingdoms of life. | 4 |
| **Genetics** | Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis, how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes, single gene disorders in humans. | 4 |
| **Biomolecules** | Molecules of life: monomeric units and polymeric structures, sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids. | 4 |
| **Enzymes** | How to monitor enzyme catalyzed reactions, enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. RNA catalysis. | 4 |
| **Information Transfer** | DNA, Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code Universality and degeneracy of genetic code, gene in terms of complementation and recombination. | 4 |
| **Macromolecular analysis** | protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements. | 5 |
| **Metabolism** | Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency, breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge. | 5 |
| | **Total No. of Hours** | **33** |
| **Textbooks** | 1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.;<br>Jackson, R. B. Pearson Education Ltd. | |
| **References** | 2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons.<br>3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company.<br>4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish<br>Kumar Jain for CBS Publisher.<br>5) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers. | |

**SEMESTER VII**

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C701 | Biomedical Instrumentation | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/EI/BT/C702 | Vacuum Instrumentation and Thin Film Deposition Techniques | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 3 | | PE-03 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | | PE-03MOOC | - | - | - | - | - | - | - | | |
| 4 | | OE-02 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | | OE-02MOOC | - | - | - | - | - | - | - | | |
| 5 | SET/EI/BT/C705 | Biomedical Instrumentation Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 6 | SET/EI/BT/C706 | Vacuum Instrumentation and Thin Film Deposition Techniques Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 7 | SET/EI/BT/C707 | Project Preparation | - | - | 2 | - | - | - | - | 100 | 3 |
| 8 | SET/EI/BT/C708 | Industrial Training Seminar | - | - | - | - | - | - | - | 100 | 2 |
| 9 | SET/HS/BT/H709 | Principles of Management (*HSMC) | 3 | 1 | - | 10 | - | 30 | 70 | 100 | 3 |
| | | | | | | | | | | **Total** | 22 |

* Humanities and Social Sciences including Management courses.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 03 (PE-03)** | 1 | SET/EI/BT/E703 (i) | Electrical Energy Conservation & Auditing |
| | 2 | SET/EI/BT/E703 (ii) | Power System Protection |
| | | SET/EI/BT/E703 (ii)MOOC | Power System Protection** |
| | 3 | SET/EI/BT/E703 (iii) | Control Systems II |
| | 4 | SET/EI/BT/E703 (iv) | Solar Energy Engineering & Technology |
| | 4 | SET/EI/BT/E703 (iv)MOOC | Solar Energy Engineering & Technology** |

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Open Elective 02 (OE-02)** | 1 | SET/EI/BT/E704 (i) | Industrial Drives and Control |
| | 2 | SET/EI/BT/E704 (ii) | Introduction to Robotics |
| | | SET/EI/BT/E704 (ii)MOOC | Introduction to Robotics ** |
| | 3 | SET/EI/BT/E704 (iii) | Computer Architecture |
| | | SET/EI/BT/E704 (iii)MOOC | Computer Architecture and Organization** |

**MOOC Course

| **SET/EI/BT/C701. BIOMEDICAL INSTRUMENTATION** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Electro physiology** | Review of physiology and anatomy, resting potential, action potential, bioelectric potentials, cardiovascular dynamics, electrode theory, bipolar and uni-polar electrodes, surface electrodes, physiological transducers. Systems approach to biological systems. | 8 |
| **Bioelectric potential and cardiovascular measurements** | EMG - Evoked potential response, EEG. ECG phonocardiography, vector cardiograph, Blood Pressure, Measurement of Blood Pressure, blood flow cardiac output, plethysmography, impedance cardiology, cardiac arrhythmia, pace makers, defibrillators. | 10 |
| **Ultrasound** | Physical principle, generation and detection of ultrasound. Application of ultrasound in bio-medical field. Block diagram of pulse-echo system. Scanner, A scan, echo-cardiograph, M-mode, B scanner, C-scan. Types of scan converter analog scan converter. Real time ultrasonic imaging systems. | 10 |
| **Imaging techniques** | Production of x-rays, block diagram of x-ray machine, x-rays Imaging techniques - CAT scan. Principle & image reconstruction techniques of NMR and MRI. | 10 |
| **Safety** | Grounding and isolation. | 6 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice Hall. | |
| **References** | 1. Geddes L. A. and Baker L. E., "Principles of Applied Biomedical Instrumentation", John Wiley.<br>2. Richard Aston, "Principles of Bio-medical Instrumentation and Measurement", Merril Publishing Company.<br>3. Kandpur R. S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill. | |

| **SET/EI/BT/C702. VACUUM INSTRUMENTATION AND THIN FILM DEPOSITION TECHNIQUES** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Definitions and Gas laws** | Pressure units, gas laws, throughput and speed, kinetic theory of gases, gas pressure, mean free path, partial pressures of gases, viscosity of gases, thermal conductivity, vapour pressure, ionization, sorption and desorption, out gassing, gettering. | 4 |
| **Theory of Gaseous Flow** | Impedance, conductance, effect on pumping speed due to a component, effect of speed in a vessel due to several pumps, mechanism of gas flow, turbulent flow, viscous flow, molecular flow, transitional flow, effect of temperature and nature of gas, conductance of the components like orifice, straight pipe of finite length, annular orifice, concentric cylinders, rectangular dent, right angled bends. | 4 |
| **Vacuum Pumps** | Rotary pump: Working and characteristics, ultimate pressure, removal of vapours: chemical, physical and gas ballasting techniques. Roots pump: Working and characteristics; Diffusion pump: Working and characteristics, multistage pumps and jet design, pump fluid, self fractionalization of the pump fluid, cooling, backing and roughening requirements, speed characteristics and ultimate pressure. Sorption pumps, cryogenic pumps, ion pumps, getter pumps, sputter-ion pumps, turbo-molecular pumps- their characteristics, merits and limitations. | 8 |

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|---|---|---|
| **Measurement of Vacuum** | Mc Leod gauge, thermo conductivity gauges: Pirani, thermocouple. Ionization gauges; Penning gauge, hot cathode ionization gauge, Bayard Alpert gauge; capacitance gauges. Calibration of gauges. | 5 |
| **Vacuum Materials** | Properties of vacuum materials; vapour pressure, out gassing, permeability, mechanical strength. Seals: demountable, permanent, elastomers, metal gaskets, glass to metal seals, ceramic to metal seals. Vacuum grease, oils, cement and waxes. Idea of designing of a vacuum system. | 5 |
| **Leak Detection** | Bubble, soap solution, spark coil, discharge tube, ultrasonic, dye penetration, thermal conductivity and mass spectrometer methods. | 3 |
| **Physical Methods of Thin Film Deposition** | Basic idea of evaporation method: source materials, resistive evaporation, electron beam evaporation, flash evaporation, laser ablation, reactive evaporation. Sputtering: DC, bias, triode, rf, magnetron, ion beam sputtering, ion plating, MBE. | 5 |
| **Chemical Methods of Thin Film Deposition** | Basic idea of Electrolytic, electroless, anodization, sol-gel, spray pyrolysis, CVD, Plasma CVD. | 4 |
| **Film Thickness Measurement & Characterization** | In situ monitoring and post deposition methods, mechanical, micro balance, electrical resistance, capacitance, ionization, quartz crystal method. | 4 |
| | **Total No. of Hours** | **42** |
| **References** | 1. A. Roth, "Vacuum Technology", North Holland.<br>2. Nigel Harris, "Modern Vacuum Practice".<br>3. Hablanian, "High Vacuum Technology" - A Practice Guide. | |

| **SET/EI/BT/E703 (i). ELECTRICAL ENERGY CONSERVATION AND AUDITING** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Energy Scenario** | Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features. | 7 |
| **Basics of Energy and its various forms** | Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion. | 7 |
| **Energy Management & Audit** | Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding<br>energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams. | 7 |
| **Energy Efficiency in Electrical Systems** | Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors. | 7 |
| **Energy Efficiency in Industrial Systems** | Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control<br>strategies and energy saving opportunities, assessment of cooling towers. | 8 |
| **Energy Efficient Technologies in Electrical Systems** | Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology. | 6 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991. | |
| **References** | 1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects.<br>2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities.<br>3. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org) | |

| **SET/EI/BT/E703 (ii). POWER SYSTEM PROTECTION** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Module-1** | Introduction to modern power system protection- philosophy and approach- Digital | 10 |

| | | |
|---|---|---|
| | protection technology overview; Phasor measurement techniques, Phasor measurement techniques, Overcurrent protection, | |
| **Module-2** | Directional Relaying, Distance Relaying, | 10 |
| **Module-3** | Transformer protection, Differential protection of Line, CT and CVT response | 10 |
| **Module-4** | Network Protection with Renewable sources, Travelling wave approach, Synchrophasor technology application | 10 |
| | **Total No. of Hours** | **40** |
| **References** | 1. Computer Relaying For Power Systems- A. G. Phadke And J S Thorp, John Wiley And Sons Ltd 2009<br>2. Modern Solutions For Protection, Control, And Monitoring Of Electric Power Systems<br>3. Power System Relaying- S. H. Horowitz And A. G. Phadke, John Wiley And Sons Ltd 2008<br>4. Numerical Differential Protection: Principles And Applications. G. Ziegler, 2012, Wiley | |

| **SET/EI/BT/E703 (ii)MOOC. POWER SYSTEM PROTECTION** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Introduction to modern power system protection- philosophy and approach- Digital protection technology overview; Phasor measurement techniques, Phasor measurement techniques, Overcurrent protection, | 10 |
| **Week 4-6** | Directional Relaying, Distance Relaying, | 10 |
| **Week 7-9** | Transformer protection, Differential protection of Line, CT and CVT response | 10 |
| **Week 10-12** | Network Protection with Renewable sources, Travelling wave approach, Synchrophasor technology application | 10 |
| | **Total No. of Hours** | **40** |
| **References** | 1. Computer Relaying For Power Systems- A. G. Phadke And J S Thorp, John Wiley And Sons Ltd 2009<br>2. Modern Solutions For Protection, Control, And Monitoring Of Electric Power Systems<br>3. Power System Relaying- S. H. Horowitz And A. G. Phadke, John Wiley And Sons Ltd 2008<br>4. Numerical Differential Protection: Principles And Applications. G. Ziegler, 2012, Wiley | |

| **SET/EI/BT/E703 (iii). CONTROL SYSTEMS II** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Review of State Space analysis** | Concepts of state space and state variables. State space representation of systems described by scalar differential equations, solution of state equation; State transition matrix. State space representation of discrete systems, Controllability and observability. | 16 |
| **Stability Analysis** | Definition, first and second methods of Liapunov: stability analysis of linear system using Liapunov's second method. Stability analysis of Nonlinear system using second method of criterion, | 8 |
| **Non-linear Systems** | Introduction: Common physical non-linearities: Phase-plane method, system analysis by phase plane method: Describing functions: Stability analysis by describing function methods. | 8 |
| **Sampled Data Systems** | Sampling process: Impulse modulation: Mathematical analysis of sampling process; Z transform and its evaluation, theorems of Z-transform: Modified Z- transform: Mapping of S-Plane into Z plane, Introduction to Adaptive Control and Parameter Identification. | 12 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Ogata K, "Modern Control Engineering", PHI 4th Ed., New Delhi (2002).<br>2. Gibson J E, "Non Linear automatic Control", MGH (Int.) (1966).<br>3. Lindorf D P, "Theory of sampled data control systems", JW (1967). | |
| **References** | 1. Atherton D P, "Non linear control engineering", Van Nostrand Reinhold, London (1975).<br>2. Kuo B C, "Analysis & Synthesis of S.D. Control Systems", PHI, New Delhi (1966). | |

| **SET/EI/BT/E703 (iv). SOLAR ENERGY ENGINEERING & TECHNOLOGY** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to solar energy** | Energy Scenario, overview of solar energy conversion devices and applications, physics of propagation of solar radiation from the sun to earth, Sun-Earth Geometry, Extra-Terrestrial and Terrestrial Radiation, Solar energy measuring instruments, Estimation of solar radiation under different climatic conditions, Estimation of total radiation | 10 |
| **Principles of solar PV cells** | Fundamentals of solar PV cells, principles and performance analysis, modules, arrays, theoretical maximum power generation from PV cells. PV standalone system components, Standalone PV-system design | 12 |

| | | |
|---|---|---|
| **Fundamentals of solar collectors** | Fundamentals of solar collectors, Snails law, Bougers law, Physical significance of Transmissivity – absorptivity product. Performance anlaysis of Liquid flat plate collectors and testing, Performance anlaysis of Solar Air heaters and testing | 12 |
| **Solar thermal power generation** | Solar thermal power generation (Solar concentrators), Thermal Energy Storage (sensible, latent and thermochemical) and solar pond, Applications: Solar Refrigeration, Passive architecture,solar distillation, and ermeging technologies. | 10 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Dubey, G.K., "Power Semiconductor Controlled Drives", prentice hall.<br>2. G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2002.<br>3. S. P. Sukhatme and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill, 2006. | |
| **References** | 1. C. S. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, Prentice Hall India, 2nd Edition, 2011.<br>2. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, 2006.<br>3. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, 1999.<br>4. H. P. Garg and J. Prakash, Solar Energy: Fundamentals and Applications, Tata McGraw Hill, 1997.<br>5. M. A. Green, Third Generation Photovoltaics: Advanced Solar Energy Conversion, Springer, 2003.<br>6. A. Goetzberger and V. U. Hoffmann, Photovoltaic Solar Energy Generation, Springer- -verlag, 2010.<br>7. K. Jager, O. Isabella, A. H. M. Smets, R.A.C.M.M. Van Swaaij, and M. Zeman, Solar Energy – fundamentals, technology and systems, Delft University of Technology, 2014<br>8. T. C. Kandpal and H.P. Garg, Financial Evaluation of Renewable Energy Technologies, McMillan India Ltd., 2013 | |

| **SET/EI/BT/E703 (iv)MOOC. SOLAR ENERGY ENGINEERING & TECHNOLOGY** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Energy Scenario, overview of solar energy conversion devices and applications, physics of propagation of solar radiation from the sun to earth, Sun-Earth Geometry, Extra-Terrestrial and Terrestrial Radiation, Solar energy measuring instruments, Estimation of solar radiation under different climatic conditions, Estimation of total radiation | 10 |
| **Week 4-6** | Fundamentals of solar PV cells, principles and performance analysis, modules, arrays, theoretical maximum power generation from PV cells. PV standalone system components, Standalone PV-system design. Components of grid-connected PV system, solar power plant design and performance analysis. | 10 |
| **Week 7-9** | Fundamentals of solar collectors, Snails law, Bougers law, Physical significance of Transmissivity – absorptivity product. Performance anlaysis of Liquid flat plate collectors and testing, Performance anlaysis of Solar Air heaters and testing | 12 |
| **Week 10-12** | Solar thermal power generation (Solar concentrators)., Thermal Energy Storage (sensible, latent and thermochemical) and solar pond, Applications: Solar Refrigeration, Passive architecture,solar distillation, and ermeging technologies. | 10 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 4. Dubey, G.K., "Power Semiconductor Controlled Drives", prentice hall.<br>5. G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2002.<br>6. S. P. Sukhatme and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill, 2006. | |
| **References** | 9. C. S. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, Prentice Hall India, 2nd Edition, 2011.<br>10. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, 2006.<br>11. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, 1999.<br>12. H. P. Garg and J. Prakash, Solar Energy: Fundamentals and Applications, Tata McGraw Hill, 1997.<br>13. M. A. Green, Third Generation Photovoltaics: Advanced Solar Energy Conversion, Springer, 2003.<br>14. A. Goetzberger and V. U. Hoffmann, Photovoltaic Solar Energy Generation, Springer- -verlag, 2010.<br>15. K. Jager, O. Isabella, A. H. M. Smets, R.A.C.M.M. Van Swaaij, and M. Zeman, Solar Energy – | |

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|---|---|
| | fundamentals, technology and systems, Delft University of Technology, 2014<br>16. T. C. Kandpal and H.P. Garg, Financial Evaluation of Renewable Energy Technologies, McMillan India Ltd., 2013 |

| SET/EI/BT/E704 (i). INDUSTRIAL DRIVES AND CONTROLS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to dc and ac motors** | Motor lead system – steady state stability criteria – Braking and speed reversal of DC and AC motors – transfer function model of separately excited and series DC motor – Equivalent circuit of Induction motor – Torque slip characteristic – Synchronous motor model. | 10 |
| **Control of dc drives** | Analysis of series and separately excited DC motor with single phase and three phase converters operating in different modes and configuration - Problems on DC machines fed by converter supplies CLC and TRC strategies. - Analysis of series and separately excited DC motors fed from different choppers, effect saturation series motors – CLC and TRC strategies – Closed loop control schemes. | 12 |
| **Control of ac drives** | Operation of Induction motor with non - sinusoidal supply wave forms, variable frequency operation of three phase Induction motors, constant flux operation, current fed operations. Dynamic and regenerative braking of CSI and VSI fed drives. Types of rotor choppers, torque equations, constant torque operations, TRC strategies, combined stator voltage control and rotor resistance control, principle of vector control – Direct and indirect FOC. | 12 |
| **Special machines** | Modeling and control schemes for PMSM, PMBLDC, stepper motor and switched reluctance motor. | 10 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 7. Dubey, G.K., "Power Semiconductor Controlled Drives", prentice hall.<br>8. Krishnan.R., "Electrical Motor Drives-Modeling, Analysis and Control", Prentice Hall. | |
| **References** | 1. Bose.B.K. "Modern Power Electronics and AC Drives", Pearson Education, 2002.<br>2. Sheperd W., Hully L.N., "Power Electronics and Motor Control",Cambridge University press, Cambridge, 1987.<br>3. Dewan S.B., Slemon G.R., and Straughen A., "Power Semiconductor Drives", John Wiley and sons, New York, 1984.<br>4. Buxbaum A., Schierau K. and Staughen, "A Design of control system for DC drives", Springer – Verlag, Berlin, 1990.<br>5. Subharamanyam V., "Electric Drives – Concepts and Applications",Tata McGraw-Hill Publishing Co. Ltd, New Delhi 1994. | |

| SET/EI/BT/E704 (ii). INTRODUCTION TO ROBOTICS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Module 1** | History, Robots, Industrial robots and their applications: robot subsystems, classification of robots, industrial applications. | 8 |
| **Module 2** | Actuators and Grippers: Electric actuators, Hydraulic actuators, Pneumatic actuators, Selection of motors, grippers, Sensor classification, Internal and External sensors, Vision. | 10 |
| **Module 3** | Transformations: robot architecture, pose of a rigid body, Coordinate transformation, forward and inverse position analysis. | 8 |
| **Module 4** | Statics and Manipulator Design: Forces and moments balance, Role of Jacobian in statics, manipulator design. | 8 |
| **Module 5** | Inertia properties, Eular-Lagrange Formulation, Newton-Eular Formulation, Dynamic modeling. Control Techniques, Nonlinear and force control. | 9 |
| | **Total No. of Hours** | **43** |
| **Textbooks** | 1. Introduction to robotics, S. K. Saha, Tata McGraw-Hill Education<br>2. Fundamentals of mechanics of robotic manipulation, Marco Ceccarelli, Springer Science. | |
| **References** | 3. Elements of robotics, Mordechai Ben-Ari, Francesco Mondada, Springer. | |

| SET/EI/BT/E704 (ii)MOOC. INTRODUCTION TO ROBOTICS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Introduction to robotics- History, growth; Robot applications- Manufacturing industry, defense, rehabilitation, medical etc., Laws of Robotics, Robot mechanisms; Kinematics-coordinate transformations, DH parameters, Forward kinematics, Inverse Kinematics. | 10 |
| **Week 4-6** | Jacobians, Statics, Trajectory Planning, Actuators (electrical)- DC motors, BLDC servo motors, Sensors, sensor integration, | 10 |
| **Week 7-9** | Control – PWM, joint motion control, feedback control, Computed torque control, Perception, Localisation and mapping, | 10 |

| | | |
|---|---|---|
| **Week 10-12** | Probabilistic robotics, Path planning, BFS; DFS; Dijkstra; A-star; D-star; Voronoi; Potential Field; Hybrid approaches; Simultaneous Localization and Mapping; Introduction to Reinforcement Learning. | 10 |
| | **Total No. of Hours** | **40** |
| **References** | 1. Robert J Schilling, Fundamentals of Robotics, Prentice Hall India<br>2. John J Craig, Introduction to Robotics, Prentice Hall International, 2005 | |

| **SET/EI/BT/E704 (iii). COMPUTER ARCHITECTURE** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Introduction and overview of computer architecture, basic computer organization, register transfer notation. General aspects of processor design, CPU organization, instruction set architecture, data types, addressing modes, program sequencing. | 6 |
| **Instructions and Assembly language Programming** | Direct, indirect, indexed, relative and immediate addressing mode. Pre and post indexing, instruction formats, zero, one, two and three address machine, different types of instructions – memory and non memory reference instructions; Assembly language – Basic I/O operations – Stacks and Queues; Assembler, Compiler, Linker. | 6 |
| **Arithmetic** | Basic structure functional blocks, register involved, fetch and execution cycle, instruction sequencing; ALU design: computer arithmetic, fixed and floating points arithmetic, logical operations; design of fast adders, multiplication and division circuits. | 6 |
| **Control unit** | Control unit concepts, execution of complete instructions, and sequencing of control signals, hardware control unit, general micro-programming concepts, micro-programmed control unit, micro-instructions and their encoding. | 6 |
| **Pipelined processing** | Pipelining, Basic Concepts, Data hazards, Instruction hazards, Influence on Instruction sets; Data path and control consideration – Superscalar operation. | 6 |
| **Memory System Design** | Memory hierarchy, system balance consideration, Speed, size and cost; memory I/O design, cache, ROM, Performance consideration, Virtual memory, Memory management requirements, Secondary storage. | 6 |
| **Input-Output Organization** | Addressing I/O devises, data transfer synchronization, interrupt handling, I/O channels, computer peripherals and interfacing, I/O interfaces I/O devices, terminals, card readers, and I/O processors, Standard I/O Interfaces (PCI, SCSI, and USB). | 6 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. Moris M Mano, "Computer System Architecture", PHI.<br>2. Roth, "Digital Design using VHDL" | |
| **References** | 1. Hennesy, Patterson, "Computer Organization and Design: the hardware/ software interface", Morgan Kauffman.<br>2. Hamacher, C., Vranesic, Z. and Zaky, S., "Computer Organization" McGraw Hill. | |

| **SET/EI/BT/E704 (iii)MOOC. COMPUTER ARCHITECTURE AND ORGANIZATION** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Evolution of Computer Systems, Instruction Set Architecture, Quantitative Principles of Computer Design. | 10 |
| **Week 4-6** | Control Unit Design, Memory System Design, Design of Cache Memory Systems. | 10 |
| **Week 7-9** | Design of Arithmetic Unit, Design of Arithmetic Unit (contd.), Input-Output System Design. | 10 |
| **Week 10-12** | Input-Output System Design (contd.), Instruction Set Pipelining, Parallel Processing Architectures. | 10 |
| | **Total No. of Hours** | **40** |

| **SET/EI/BT/C705. BIOMEDICAL INSTRUMENTATION LAB** | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Study of electrodes.<br>2. Measurement of BP.<br>3. Measurement of PH.<br>4. Study of EEG, ECG, CAT-SCAN.<br>5. Visit to Pathological Lab.<br>6. Hospital visit to see demonstration of EEG, ECG, and CAT-SCAN.<br>7. MATLAB Simulation for biomedical signal analysis. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/EI/BT/C706. VACUUM INSTRUMENTATION AND THIN FILM DEPOSITION TECHNIQUES LAB | |
|---|---|
| **Content** | **No. of Hrs.** |
| 1. Study of rotary pump.<br>2. Study of diffusion pump.<br>3. Study of LPCVD setup.<br>4. Study of Oven.<br>5. Creating a vacuum.<br>6. Measurement of Vacuum/ low pressure.<br>7. Deposition of thin film.<br>8. Characterization of thin film properties. | 14x2 |
| **Total No. of Hours** | **28** |

| SET/EI/BT/C707 PROJECT PREPARATION | |
|---|---|
| **Content** | **No. of Hrs.** |
| Project Preparation includes following assignments.<br>• Survey and study of published literature on the assigned topic;<br>• Working out a preliminary approach to the Problem relating to the assigned topic;<br>• Conducting Preliminary Analysis/ Modeling/ Experiment/ Simulation/ Experiment/ Design/ Feasibility<br>• Preparing a Written Report on the Study conducted for presentation to the Department;<br>• Final Seminar, as oral Presentation before a Departmental Committee. | 24x2 |
| **Total No. of Hours** | **48** |

| SET/EI/BT/C708 INDUSTRIAL TRAINING SEMINAR | |
|---|---|
| **Content** | **No. of Hrs.** |
| Student shall prepare a detailed report on her/his industrial training and deliver a seminar of 30 minutes. | 24x2 |
| **Total No. of Hours** | **48** |

| SET/HS/BT/H709. PRINCIPLES OF MANAGEMENT | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **General Management** | Nature, scope and significance of management. Process and functions of management. Overview of the functional areas of the general management. | 6 |
| **Financial Management** | Traditional and modern concept of finance function, nature, scope and significance of finance and financial management, functions of financial managers and financial decisions, financial environment. | 6 |
| **Marketing Management** | Nature, concept, scope and significance of marketing management, functions of marketing management, marketing planning and marketing mix. | 6 |
| **Product Development** | Concept, nature, significance of product management, product value, types of products, new product development, product life cycle, functions of product managers. | 6 |
| **Human Resource Management** | Concept, nature, scope, importance of human factor in managing modern organizations, functions of human resource mangers; Planning, organizing, directing, motivation, control and co-ordination. | 6 |
| **Operations Management** | Concept of operations management, tools and techniques: PERT, CEPM, JIT, KANBAN, Inventory management, six sigma, TQM, SCM; | 6 |
| **Production Management** | Concept, nature and significance of production management, functions of production managers. | 6 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. B. S. Goyal, "Production and Operations Management", Pragati Prakashan, 2002. | |
| **References** | 1. O. D. W. Koontz, "Elements of Management", Tata McGraw Hill.<br>2. T. N. Chabara, "Principles and Practice of Management", Dhanpat Rai & Co.<br>3. M. Y. Khan, "Financial Management", Tata McGraw-Hill.<br>4. I. M. Pandey, "Financial Management", Vikas Publishing.<br>5. P. Kotler, Marketing Management: Analysis", The Prentice-Hall.<br>6. E. B. Flippo, "Principles of Personnel Management", New York, McGraw-Hill. | |

.**SEMESTER VIII**

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | PE-04 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | | PE-04MOOC | - | - | - | - | - | - | - | | |
| 2 | | OE-03 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | | OE-03MOOC | - | - | - | - | - | - | - | | |
| 3 | | OE-04 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | | OE-04MOOC | - | - | - | - | - | - | - | | |
| 4 | SET/EI/BT/C804 | Major Project | - | - | 16 | - | - | - | - | 100 | 8 |
| | | | | | | | | | | **Total** | 17 |

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 04 (PE-04)** | 1 | SET/EI/BT/E801 (i) | Renewable Energy Engineering |
| | | SET/EI/BT/E801 (i)MOOC | Non-conventional Energy Resources* |
| | 2 | SET/EI/BT/E801 (ii) | Electrical Distribution System |
| | 3 | SET/EI/BT/E801 (iii) | Control Systems Design |
| | 4 | SET/EI/BT/E801 (iv) | Switchgear and Protection |

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Open Elective 03 and 04 (OE-03, OE-04)** | 1 | SET/EI/BT/E802 (i) | Data Communication and Networking |
| | 2 | SET/EI/BT/E802 (ii) | Fuzzy Logic & Neural Network |
| | | SET/EI/BT/E802 (ii)MOOC | Fuzzy Sets, Logic And Systems & Applications * |
| | 3 | SET/EI/BT/E802 (iii) | Virtual Instrumentation |
| | 4 | SET/EI/BT/E802 (iv) | Mobile Communication and Networks |

*MOOC Course

* The Major Project(s) will be evaluated on the basis of the weightage of 20% of Report writing, 50% of the Project work and 30% for Presentation and Viva. There shall be two presentations for each Project evaluation and at least one outside expert will be the member of the evaluation committee for final evaluation.

| **SET/EI/BT/E801 (i). RENEWABLE ENERGY ENGINEERING** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction** | Energy sources and their availability- conventional and renewable energy sources, prospects of renewable energy. Energy conservation and energy audit. | 6 |
| **Solar Energy** | Solar radiation and its measurement, solar constant, solar radiation at earth's surface, solar radiation geometry, estimation of average solar radiation, solar radiation at tilted surfaces. Photo-thermal conversion- Physical principles of solar radiation into heat, solar energy collectors- flat plate and focusing type, energy balance equation and collector efficiency, Selective absorbing coatings. Useful heat gained by collector fluid. Solar energy storage systems- solar ponds and extraction of thermal energy. Applications of photo-thermal energy, photo-voltaic: Principle and materials, solar cells, their combination, storage of photovoltaic energy. | 8 |
| **Wind Energy** | Nature of wind, power of wind, forces on rotor blades, wind energy conversion, energy estimation, site selection considerations, types of wind machines- horizontal axial and vertical axial machines, aerodynamic forces acting on blades, energy storage, applications of wind energy. | 8 |
| **Geothermal Biomass energy** | Biomass conversion technologies- wet and dry processes, photosynthesis, biogas plants, fuel properties of biogas, thermal gasification of biomass. Nature of geothermal fields, geothermal sources, energy estimation, application of geothermal energy. | 6 |
| **Mini and micro hydro** | Components, turbine and generators for small scale hydro, protection, control and management of equipments. | 6 |
| **Chemical** | Fuel cells, design and principle, types, conversion efficiency, types of electrodes, work output | 8 |

| | | |
|---|---|---|
| **energy sources** | and EMF of fuel cells. Batteries- basic theory, types, characteristics, different batteries arrangements. Hydrogen energy- methods of hydrogen production, hydrogen storage. | |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. D. P. Kothari, "Renewable Energy Resources", PHI Publications. | |
| **References** | 1. G. D. Rai, "Non- conventional sources of energy", Khanna Publishers, Delhi. | |

| **SET/EI/BT/E801 (i)MOOC. NON-CONVENTIONAL ENERGY RESOURCES** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Scale of quantities, Impact of current energy usage, Conventional sources of energy<br>Overview of non-conventional energy resources, Consumption by sector<br>Solar energy incident on earth, solar spectrum | 10 |
| **Week 4-6** | Overview of solar energy technologies, Solar Thermal devices<br>Solar Photovoltaic devices, Performance and durability of solar devices<br>Wind energy, technology and geographical aspects | 10 |
| **Week 7-9** | Geothermal and Biomass<br>Battery basics, types<br>Testing, performance of batteries | 10 |
| **Week 10-12** | Fuel cell types, Fuel processing, concept to product.<br>Characterization and durability of fuel cells<br>Flywheels and super capacitors | 10 |
| | **Total No. of Hours** | **40** |
| **Textbooks** | 1. D. P. Kothari, "Renewable Energy Resources", PHI Publications. | |
| **References** | 1. G. D. Rai, "Non- conventional sources of energy", Khanna Publishers, Delhi. | |

| **SET/EI/BT/E801 (ii). ELECTRICAL DISTRIBUTION SYSTEM** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **General concepts** | Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, Contribution factor loss factor-relationship between the load factor and loss factor. Classification of loads (Residential, Commercial, Agricultural and industrial) and their characteristics. | 5 |
| **Distribution feeders** | Design consideration of distribution feeders: Radial and loop types of primary feeders, Voltage levels, Feeder loading; Basic design practice of the secondary distribution system. Substations: location of substation. | 6 |
| **Underground Cables** | Introduction, Insulation, Sheath, Armour and Covering, Classification of Cables, Pressurized Cables, Effective Conductor Resistance, Conductor Inductive Reactance, Parameters of Single Core Cables, Grading of Cables, Installation, Current Rating of Cables, System Operating Problems with Underground Cables, HVDC Cables. | 14 |
| **System Analysis** | Voltage drop and power-loss calculations, Derivation for voltage drop and power loss in lines, Three phase balanced primary lines. | 4 |
| **Protection** | Objectives of distribution system protection, Types of common faults and procedure for fault calculations. Protective devices: Principle of operation off uses, Circuit re-closures, Line sectionalizes, and Circuit breakers. | 5 |
| **Coordination** | Coordination of protective devices: General coordination procedure. Compensation for power factor improvement, Capacitive compensation for power-factor control. Different types of power capacitors, Shunt and series capacitors. | 8 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. Gonen, T., Electric Power Distribution System Engineering, 3rd edition CRC Press 2014.<br>2. Pabla, A.S., Electric Power Distribution, 6th ed., Tata McGraw Hill, 2012. | |
| **References** | 1. Sivanagaraju, S. and Sankar, V., Electrical Power Distribution and Automation, Dhanpat Rai & Co, 2006.<br>2. Kamaraju, V., Electrical Power Distribution Systems, Tata McGraw Hill Education, New Delhi, 2011. | |

| **SET/EI/BT/E801 (iii). CONTROL SYSTEMS DESIGN** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Design Specifications** | Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of addition of pole on system performance. Effect of addition of zero on system response. | 10 |
| **Design of Classical Control System in the time domain** | Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators. | 6 |
| **Design of Classical Control System in frequency domain** | Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram. | 6 |
| **Design of PID controllers** | Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control. | 6 |
| **Control System** | Review of state space representation. Concept of controllability & observability, effect of | 10 |

| | | |
|---|---|---|
| **Design in state space** | pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. | |
| **Nonlinearities and its effect on system performance** | Various types of non-linearities. Effect of various non-linearities on system performance. Singular points. Phase plot analysis. | 4 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. N. Nise, "Control system Engineering", John Wiley, 2000. | |
| **References** | 2. I. J. Nagrath and M. Gopal, "Control system engineering", Wiley, 2000.<br>3. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.<br>4. K. Ogata, "Modern Control Engineering", Prentice Hall, 2010.<br>5. B. C. Kuo, "Automatic Control system", Prentice Hall, 1995.<br>6. J. J. D'Azzo and C. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill, 1995.<br>7. R. T. Stefani and G. H. Hostetter, "Design of feedback Control Systems", Saunders College Pub, 1994. | |

| **SET/EI/BT/E801 (iv). SWITCHGEAR AND PROTECTION** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Faults in Power Supply System** | Symmetrical component transformation. Three phase power in unbalanced circuit in terms of symmetrical component. Transformer transmission line & passive loads. Phase shift in Y/delta three phase transformers (Yd1, Yd11 connection). Symmetrical fault analysis without & with pre-fault load currents. | 10 |
| **Unsymmetrical fault analysis and protective relaying** | L-G, L-L-G-, L-L, open conductors fault using symmetrical components. Protective zones. Primary protection, back up protection, remote and local back up. Medium voltage line protection: over current relaying directional over current relays. | 10 |
| **High voltage line protection** | Distance relays, carrier distance schemes. Unit carrier schemes. | 2 |
| **Equipment protection** | Principles of differential relaying, protection of generator, transformers and busbars by differential relaying and other relays. Protection of induction motor's against overload, short-circuits, | 6 |
| **Introduction to numerical relays** | Comparison of static and electro-mechanical relays, two input amplitude and phase comparators and their duality. Switchgear: circuit breakers, arc interruption theory, recovery. | 8 |
| **Switchgear** | circuit breakers, arc interruption theory, recovery and restriking voltages, RRRV, breaking of inductive and capacitive current, C.B. ratio, different media of arc interruption, SF6 and vacuum breakers. | 6 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. Ram, B. and Vishwakarma, D.N. Power System Protection & Switchgear,2nd ed., Tata McGraw Hill, 2013.<br>2. Paithankar, Y.G. and Bhide, S.R., Fundamentals of Power System Protection, 2nd ed., PHI Learning, 2013 | |
| **References** | 1. Elmore, W.A, Protective Relaying Theory and Applications, 2nd ed., MarcelDekker, New York, 2004.<br>2. Mason, C.R., Art and Science of Protective Relaying, Wiley, New York, 1968.<br>3. Warrington, A.R.V., Protective Relays: Their Theory and Practice (Vol. I & Vol. II), 3rd ed., Chapman and Hall, London, 1978. | |

| **SET/EI/BT/E802 (i). DATA COMMUNICATION AND NETWORKING** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Introduction to networks** | Networks: Components and Categories, Types of Connections,Topologies, Transmission Media, Coaxial Cable, Fiber Optics, ISO/OSI Model. | 8 |
| **Data link layer** | Error- Detection and correction, Parity, LRC, CRC, Hamming code, Low Control and Error control, Stop and wait, ARQ, Sliding window, HDLC, LAN, IEEE 802 Standards, Wireless LAN, Bridges. | 8 |
| **Network layer** | Inter-networks, Packet Switching and Datagram approach, IP addressing methods, Sub-netting, Routing, Distance Vector Routing, Link State Routing, Routers. | 8 |
| **Transport layer** | Duties of transport layer, Multiplexing, De-multiplexing, Sockets, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Congestion Control, Quality of Services (QOS) | 8 |
| **Application layer** | Domain Name Space (DNS), SMTP, FTP, HTTP –WWW, Network Security. | 4 |
| **Industrial Data** | RS – 232 AND RS – 485, 20ma current loop – Serial interface converters; MODBUS protocol, Data highway (plus) protocol; HART Protocol; Introduction to AS–interface | 6 |

| | | |
|---|---|---|
| **Networks** | and Device-Net; Introduction to Profibus; Foundation field bus versus Profibus; 10Mbps Ethernet; 100Mbps; | |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. Behrouz A. Forouzan, "Data communication and Networking". Tata McGrawHill, 2004<br>2. Mackay, S., Wrijut, E., Reynders, D. and Park, J., "Practical Industrial DataNetworks Design, Installation and Troubleshooting", Newnes Publication,Elsevier, 1st Edition, 2004. | |
| **References** | 1. Andrew S. Tanenbaum, "Computer Networks". PHI, Fourth Edition, 2003.<br>2. William Stallings, " Data and Computer Communication", Sixth Edition, PearsonEducation<br>3. Leon-Garcia, Widjaja: Communication Networks, TMH.<br>4. Buchanan, W., "Computer Busses", CRC Press, 2000<br>5. Stallings, W., "Wireless Communication and Networks", 2nd Edition, PrenticeHall of India. | |

| **SET/EI/BT/E802 (ii). FUZZY LOGIC & SYSTEMS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Fuzzy Logic Introduction** | Basic concepts of fuzzy logic, Fuzzy logic crisp set, Linguistic variable, Membership functions, fuzzy set theory and their arithmetic Operation, Basic fuzzy inference algorithm, Application of fuzzy logic, Fuzzy system design, | 10 |
| **Set Theoretic Operations** | Membership Functions, Set Theoretic Operations, Fuzzy Arithmetic | 12 |
| **Fuzzy Relations** | Fuzzy Inference Systems I and II, Wang and Mendel Model, TSK Model | 10 |
| **Fuzzifiers and Defuzzifiers** | Fuzzifiers and Defuzzifiers, ANFIS Architecture, Fuzzy Systems and Machine Learning | 10 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. Riza Berkin and Trubatch, "Fuzzy System Design Principles", PHI (2000).<br>2. Yegna Narayenan, "Artificial Neural Networks", MGH (1999).<br>3. Bart Kosko, "Nueral Networks and Fuzzy Logic", PHI, New Delhi (1998).<br>4. Ross, T. J. (2005), "Fuzzy logic with engineering applications," John Wiley & Sons. | |
| **References** | 1. Simon Haykin, "Neural Networks", Pearson Education (2002).<br>2. Anderson J A "An Introduction to Neural Networks", PHI, New Delhi (1998). | |

| **SET/EI/BT/E802 (ii)MOOC. FUZZY SETS, LOGIC AND SYSTEMS & APPLICATIONS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Fuzzy Logic Introduction** | Basic concepts of fuzzy logic, Fuzzy logic crisp set, Linguistic variable, Membership functions, fuzzy set theory and their arithmetic Operation, Basic fuzzy inference algorithm, Application of fuzzy logic, Fuzzy system design, | 10 |
| **Set Theoretic Operations** | Membership Functions, Set Theoretic Operations, Fuzzy Arithmetic | 12 |
| **Fuzzy Relations** | Fuzzy Inference Systems I and II, Wang and Mendel Model, TSK Model | 10 |
| **Fuzzifiers and Defuzzifiers** | Fuzzifiers and Defuzzifiers, ANFIS Architecture, Fuzzy Systems and Machine Learning | 10 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. Riza Berkin and Trubatch, "Fuzzy System Design Principles", PHI (2000).<br>2. Yegna Narayenan, "Artificial Neural Networks", MGH (1999).<br>3. Bart Kosko, "Nueral Networks and Fuzzy Logic", PHI, New Delhi (1998).<br>4. Ross, T. J. (2005), "Fuzzy logic with engineering applications," John Wiley & Sons. | |
| **References** | 1. Simon Haykin, "Neural Networks", Pearson Education (2002).<br>2. Anderson J A "An Introduction to Neural Networks", PHI, New Delhi (1998).<br>3. J.-S. R. Jang, C.-T. Sun, and E. Mizutani, "Neuro-Fuzzy and Soft Computing" Prentice Hall. | |

| **SET/EI/BT/E802 (iii). VIRTUAL INSTRUMENTATION** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Virtual Instrumentation** | Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, and comparison with conventional programming. Introduction to LabView. Tools Palette , Controls Palette Controls and Indicators Numeric Controls and Indicators Boolean Controls and Indicators Configuring Controls and Indicators, Functions Palette | 9 |
| **VI programming techniques** | VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web. | 8 |
| **Data acquisition basics** | Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements. | 8 |
| **VI Chassis requirements** | Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. | 8 |

| | | |
|---|---|---|
| | Networking basics for office & Industrial applications, VISA and IVI. | |
| **Applications** | VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control. | 9 |
| | **Total No. of Hours** | **42** |
| **Textbooks** | 1. Nadovich, C., "Synthetic Instruments Concepts and Applications", Elsevier.<br>2. Gary Johnson, "LabVIEW Graphical Programming", McGraw Hill.<br>3. Lisa K. wells & Jeffrey Travis, "LabVIEW for everyone", Prentice Hall.<br>4. Jane W. S. Liu, "Real-time Systems", Pearson Education.<br>5. Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready-to-use Modules in C", CMP Books. | |
| **References** | 1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes.<br>2. Jean J. Labrosse, "MicroC/OS-II. The Real-time Kernal", CMP Books.<br>3. Buchanan, W., "Computer Busses", CRC Press, 2000.<br>4. www.ni.com.<br>5. www.ltrpub.com. | |

| **SET/EI/BT/E802 (iv). MOBILE COMMUNICATION AND NETWORKS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Module 1** | Introduction to RF propagation, multi-path fading, mobile channel description and analysis, RF circuits and systems | 8 |
| **Module 2** | Mobile communication concepts, cellular engineering, cellular concepts, frequency allocation, spectrum efficiency, speech coding, modulation/demodulation techniques, multiple access techniques-FDMA, TDMA, CDMA, Spread Spectrum Techniques. | 12 |
| **Module 3** | Error control coding for mobile channel, communication applications, capacity of cellular communication networks, mobile communication standards. | 10 |
| **Module 4** | Wireless data communication systems, wireless multimedia, ATM and IP, paging, wireless local loops. Mobile satellite communication, third generation cellular systems, GSM systems, universal mobile telecommunication systems. | 14 |
| | **Total No. of Hours** | **44** |
| **Textbooks** | 1. Rappa port, "Wireless Communication" | |
| **References** | 1. William Stalling, "Wireless Communication and Networks"<br>2. D. R. Kamilo Fehar, "Wireless digital communication"<br>3. Haykin S &Moher M., "Modern wireless communication", Pearson. | |

| **SET/EI/BT/C803. MAJOR PROJECT** | |
|---|---|
| **Content** | **No. of Hrs.** |
| The Major Project(s) will be evaluated on the basis of the weightage of 20% of Report writing, 50% of the Project work and 30% for Presentation and Viva. There shall be two presentations for each Project evaluation and at least one outside expert will be the member of the evaluation committee for final evaluation. | 16 x 2 = 32 |

The syllabus has been framed in accordance with the AICTE Guidelines/ UGC Norms.

Prof. R. S. Rana

Prof. S. C. Bhatt

Mr. G. S. Kathait

Prof. V. M. Mishra

Prof. N. S. Panwar

# Curriculum and Syllabus update

## B. TECH.

## Electrical and Instrumentation Engineering

Introduction of MOOC's/SWAYAM courses for upcoming semester

(Applicable for 2018-19 batch and onwards)

**Department of Instrumentation Engineering**
**School of Engineering and Technology,**
**H. N. B. Garhwal University,**
**Srinagar Garhwal, Uttarakhand- 246174**

# Curriculum

**Definitions/ Descriptions**

1. **Credit Equivalent**

| | No. of Contact Hours per Week | Equivalent Credits |
|---|---|---|
| **Lecture+ Tutorial** | **4/3** | **3** |
| **Practical** | **2** | **1** |

***Mandatory Induction Program**

| 3 weeks duration |
|---|
| • *Physical activity*<br>• *Creative Arts*<br>• *Universal Human Values*<br>• *Literary*<br>• *Proficiency Modules*<br>• *Lectures by Eminent People*<br>• *Visits to local Areas*<br>• *Familiarization to Dept./Branch & Innovations* |

***Induction program for students to be offered right at the start of the first year. Appendix –I sheet has attached for details.**

2. **Code for Courses:**

Code for a course consists of two alphabets followed by three digits and an optional alphabet.

- First three alphabets represent the school name (SET: School of Engineering and Technology).
- Next two alphabets in the code represent the subject area of the course. E.g. (SH: Applied Science and Humanities, EC: Electronics and Communication Engineering, EI: Electrical and Instrumentation Engineering, EE: Electrical Engineering, ME: Mechanical Engineering, CS: Computer Science and Engineering, IT: Information Technology, AECC: Ability Enhancement Compulsory Courses, HS: Humanities and Social Sciences including Management courses, MC: Mandatory Course).
- Then there will be subject code with 4 letters out of which first will tell the nature of subject (C: Core/E: Elective/S: Skill Enhancement/M: Mandatory Course/H: Humanities/A: Applied Science) and next three letters will tell the number according to the semester(for example 801 will tell its 8$^{th}$ semester subject). First digit represents the semester. Next two digits represent the sequence number of course in the list of courses of a semester. Last word in few courses is MOOC, which represents that course may be opted from SWAYAM Portal.

**Elective Course:**

Elective courses are provided in V, VI, VII and VIII semesters to provide student with flexibility to choose courses of their interest from a list of offered electives. These Electives are the courses offered by the same department or other departments for the students.

**MOOC Courses:**

"MOOCs" means Massive Open Online Courses (MOOCs) are such online courses which are developed and made available on the SWAYAM platform of Government of India. MOOCs guidelines on online learning issued by the MHRD vide orders dated 11$^{th}$ March 2016 and subsequent addendums issued by the MHRD.

Any candidate can be permitted to opt for only up to 20% of the total courses being offered in a particular program in a semester through the online learning courses provided through SWAYAM platform

## Semester-wise list of subjects

### Semester I

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C101 | Mathematics I | 3 | 1 | - | 4 | 3 |
| 2 | SET/SH/BT/C102 | Physics | 3 | 1 | - | 4 | 3 |
| | SET/SH/BT/C203 | Chemistry | | | | | |
| 3 | SET/EE/BT/C103 MOOC | Fundamentals of Electrical Engineering* | - | - | - | 4 | 3 |
| | SET/EE/BT/C103 | Basic Electrical Engineering | 3 | 1 | - | | |
| | SET/ME/BT/C202 | Basic Mechanical Engineering | | | | | |
| 4 | SET/EC/BT/C104 | Basic Electronics | 3 | 1 | - | 4 | 3 |
| | SET/ME/BT/C204 | Engineering Mechanics | | | | | |
| 5 | SET/IT/BT/C105 | Fundamentals of Information Technology | 3 | 1 | - | 4 | 3 |
| | SET/CS/BT/C205 | Computer Programming | | | | | |
| 6 | AECC106 | *Environmental Science | 2 | - | - | 2 | 2 |
| 7 | SET/SH/BT/C106 | Physics Lab | - | - | 2 | 2 | 1 |
| | SET/SH/BT/C207 | Chemistry Lab | | | | | |
| 8 | SET/EE/BT/C107 | Basic Electrical Engineering Lab | - | - | 2 | 2 | 1 |
| | SET/ME/BT/C206 | Basic Mechanical Engineering Lab | | | | | |
| 9 | SET/IT/BT/C108 | Information Technology Lab | - | - | 2 | 2 | 1 |
| | SET/CS/BT/C208 | Computer Programming Lab | | | | | |
| 10 | SET/ME/BT/S109 | ***Engineering Graphics | - | - | 4 | 4 | 2 |
| **Total** | | | 17 | 5 | 10 | 32 | 22 |

*MOOC Course, ** Ability Enhancement Compulsory course.
***Skill Enhancement Course.

### Semester IV

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C401 | Sensors and Transducers | 3 | 1 | - | 4 | 3 |
| 2 | SET/EC/BT/C402 | Analog Integrated Circuits | 3 | 1 | - | 4 | 3 |
| 3 | SET/EI/BT/C403 | Microprocessors and Microcontrollers | 3 | 1 | - | 4 | 3 |
| 4 | SET/EI/BT/C404 | Analytical Instruments | 3 | 1 | - | 4 | 3 |
| 5 | SET/EC/BT/C405 | Electromagnetic Field Theory | 3 | 1 | - | 4 | 3 |
| 6 | SET/EI/BT/C406 | Circuit Theory | 3 | 1 | - | 4 | 3 |
| | SET/EI/BT/C406MOOC | Network Analysis* | - | - | - | | |
| 7 | SET/EC/BT/C407 | Analog Integrated Circuits Lab | - | - | 2 | 2 | 1 |
| 8 | SET/EI/BT/C408 | Microprocessors and Microcontrollers Lab | - | - | 2 | 2 | 1 |
| 9 | SET/EI/BT/C409 | Sensors and Transducers Lab | - | - | 2 | 2 | 1 |
| 10 | SET/EI/BT/C410 | Analytical Instruments Lab | - | - | 2 | 2 | 1 |
| 11 | SET/MC/BT/M411 | Essence of Indian Traditional Knowledge (*MC) | - | - | - | Self study | Qualifying |
| **Total** | | | 18 | 6 | 8 | 32 | 22 |

*MOOC Course, ** Mandatory Course.

### Semester V

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| | SET/EI/BT/C501 | Power Systems | 3 | 1 | - | 4 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C501 MOOC | Power systems analysis* | - | - | - | - | 3 |
| 2 | SET/EI/BT/C502 | Control Systems | 3 | 1 | - | 4 | 3 |
| | SET/EI/BT/C502 MOOC | Control Systems* | - | - | - | - | |
| 3 | SET/EI/BT/C503 | Industrial Instrumentation | 3 | 1 | - | 4 | 3 |
| 4 | SET/EI/BT/C504 | Power Electronics | 3 | 1 | - | 4 | 3 |
| | SET/EI/BT/C504 MOOC | Power Electronics* | - | - | - | - | |
| 5 | | PE-01 | 3 | 1 | - | 4 | 3 |
| 6 | SET/EI/BT/C506 | Power Systems Lab | - | - | 2 | 2 | 1 |
| 7 | SET/EI/BT/C507 | Control Systems Lab | - | - | 2 | 2 | 1 |
| 8 | SET/EI/BT/C508 | Industrial Instrumentation Lab | - | - | 2 | 2 | 1 |
| 9 | SET/EI/BT/C509 | Power Electronics Lab | - | - | 2 | 2 | 1 |
| 10 | SET/HS/BT/H510 | Foundations of Yoga (**HSMC) | 3 | 1 | - | 4 | 3 |
| **Total** | | | 18 | 7 | 8 | 32 | 22 |

*MOOC Course, ** Humanities and Social Sciences including Management courses.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 01 (PE-01)** | 1 | SET/EI/BT/E505 (i) | Electrical Drives |
| | 2 | SET/EI/BT/E505 (ii) | Line Commutated and Active PWM Rectifiers |
| | 3 | SET/EI/BT/E505 (iii) | Electrical Machine Design |

## Semester VIII

| S. No. | Code | Course Title | L | T | P | Contact Hrs./Week | Credits |
|---|---|---|---|---|---|---|---|
| 1 | | PE-04 | 3 | 1 | - | 4 | 3 |
| | | PE-04MOOC | - | - | - | 4 | |
| 2 | | OE-04 | 3 | 1 | - | 4 | 3 |
| 3 | | OE-05 | 3 | 1 | - | 4 | 3 |
| 4 | SET/EI/BT/C804 | Major Project | - | - | 16 | 16 | 8 |
| **Total** | | | 9 | 3 | 16 | 28 | 17 |

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 04 (PE-04)** | 1 | SET/EI/BT/E801 (i) | Renewable Energy Engineering |
| | | SET/EI/BT/E801 (i)MOOC | Non-conventional Energy Resources* |
| | 2 | SET/EI/BT/E801 (ii) | Electrical Distribution System |
| | 3 | SET/EI/BT/E801 (iii) | Control Systems Design |
| | 4 | SET/EI/BT/E801 (iv) | Switchgear and Protection |

*MOOC Course,

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Open Elective 04 and 05 (OE-04, OE-05)** | 1 | SET/EI/BT/E802 (i) | Data Communication and Networking |
| | | SET/EI/BT/E803 (i) | |
| | 2 | SET/EI/BT/E802 (ii) | Virtual Instrumentation |
| | | SET/EI/BT/E803 (ii) | |
| | 3 | SET/EI/BT/E802 (iii) | Smart Grid Technology |
| | | SET/EI/BT/E803 (iii) | |
| | 4 | SET/EI/BT/E802 (iv) | Mobile Communication and Networks |
| | | SET/EI/BT/E803 (iv) | |

## Note

(1) Topic for the Seminar in 6th semesters shall be chosen by students in consultation with faculty. Topic shall not be mentioned in the syllabus anywhere, however, it should be related to Electrical and Instrumentation Engineering.
(2) Students shall choose 2 professional & 2 open elective subjects in 7th Semester and 1 professional & 2 open elective subjects in 8th semester, each from the given Table. An elective subject shall be offered only when at least 30% of the intake opt for that subject.
(3) Desirous students opting for an online course would be required to register for the MOOCs for that course/paper through SWAYAM-NPTEL Local Chapter and it will be mandatory for her/him to share necessary information with the college /institute.
(4) Major Project work shall be carried out during the 7th and 8th semester. Students can undertake Major Project individually or in group of not more than Four students, under the guidance of a faculty or a group of faculty. Students have to present Synopsis of Major Project during the 7th semester. Feasibility of the Project shall be assessed by the project evaluation committee of the department before the end of 7th semester. However, Major Project would be evaluated in the end of 8th semester.

**Detailed Syllabi**

**SEMESTER I**

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/SH/BT/C101 | Mathematics I | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/SH/BT/C102 | Physics | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/SH/BT/C203 | Chemistry | | | | | | | | | |
| 3 | SET/EE/BT/C103MOOC | Fundamentals of Electrical Engineering* | - | - | - | - | - | - | - | 100 | 3 |
| | SET/EE/BT/C103 | Basic Electrical Engineering | 3 | 1 | - | 10 | 20 | 30 | 70 | | |
| | SET/ME/BT/C202 | Basic Mechanical Engineering | | | | | | | | | |
| 4 | SET/EC/BT/C104 | Basic Electronics | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/ME/BT/C204 | Engineering Mechanics | | | | | | | | | |
| 5 | SET/IT/BT/C105 | Fundamentals of Information Technology | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/CS/BT/C205 | Computer Programming | | | | | | | | | |
| 6 | AECC106 | **Environmental Science | 2 | - | - | 10 | 20 | 30 | 70 | 100 | 2 |
| 7 | SET/SH/BT/C106 | Physics Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/SH/BT/C207 | Chemistry Lab | | | | | | | | | |
| 8 | SET/EE/BT/C107 | Basic Electrical Engineering Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/ME/BT/C206 | Basic Mechanical Engineering Lab | | | | | | | | | |
| 9 | SET/IT/BT/C108 | Information Technology Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| | SET/CS/BT/C208 | Computer Programming Lab | | | | | | | | | |
| 10 | SET/ME/BT/S109 | ***Engineering Graphics | | | 4 | 30 | - | 30 | 70 | 100 | 2 |
| | | | | | | | | | | **Total** | 22 |

*MOOC Course, ** Ability Enhancement Compulsory course.
***Skill Enhancement Course.

L - Lecture hours, T - Tutorial hours, P - Practical hours, T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

## MOOC's/SWAYAM Courses introduced in First Semester:

| SET/EE/BT/C103MOOC. FUNDAMENTAL OF ELECTRICAL ENGINEERING | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Basic Concepts and Basic Laws, Methods of Analysis, DC Network Theorems | 10 |

| | | |
|---|---|---|
| **Week 4-6** | Capacitors and Inductors and First Order Circuits, Sinusoidal and Phasors, Sinusoidal Steady-State Analysis | 10 |
| **Week 7-9** | AC Circuit Analysis and Network Theorems, Series and Parallel Resonance and Magnetically Coupled Circuits. Three Phase Circuits and Power Measurements | 10 |
| **Week 10-12** | Single Phase Transformers, Three Phase Induction Machines, DC Machines. | 10 |
| | **Total No. of Hours** | **40** |
| **Textbooks** | 1. I.J. Nagrath, "Basic Electrical Engineering," Tata Mc. Graw Hill. | |
| **References** | 1. A. E. Fitgerald, D.E., Higginbotham and A Grabel, "Basic Electrical Engineering", Mc Graw Hill.<br>2. Rizzoni, Principles and Applications of Electrical Engineering, TMH.<br>3. V. Del Toro. "Principles of electrical Engineering, "Prentice hall.<br>4. W.H. Hayt & J.E. Kemmerly," Engineering circuit Analysis, "Mc Graw Hill.<br>5. H. Cotton, "Advanced Electrical Technology" Wheeler Publishing. | |

**SEMESTER IV**

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C401 | Sensors and Transducers | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | SET/EC/BT/C402 | Analog Integrated Circuits | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 3 | SET/EI/BT/C403 | Microprocessors and Microcontrollers | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 4 | SET/EI/BT/C404 | Analytical Instruments | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 5 | SET/EC/BT/C405 | Electromagnetic Field Theory | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 6 | SET/EI/BT/C406 | Circuit Theory | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EI/BT/C406MOOC | Network Analysis* | - | - | - | - | - | - | - | | |
| 7 | SET/EC/BT/C407 | Analog Integrated Circuits Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 8 | SET/EI/BT/C408 | Microprocessors and Microcontrollers Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 9 | SET/EI/BT/C409 | Sensors and Transducers Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 10 | SET/EI/BT/C410 | Analytical Instruments Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 11 | SET/MC/BT/M411 | Essence of Indian Traditional Knowledge (*MC) | - | - | - | - | - | - | - | 100 | - |
| | | | | | | | | | | **Total** | 22 |

*Mandatory Course.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

## MOOC's/SWAYAM Courses introduced in Fourth Semester:

| SET/EI/BT/C406MOOC. NETWORK ANALYSIS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Introduction to Network, circuit elements & sources. KVL & KCL, Solution of linear differential equation with different excitation, Deeper look into energy storing elements, inductor and capacitor. | 10 |
| **Week 4-6** | Ideal and practical voltage & current sources. Mesh and nodal analysis of networks. ransforming voltage to current source and vicr-versa. Thevenin / Norton's equivalent circuit. | 10 |
| **Week 7-9** | Tellegen Theorem and its implication. Theory of reciprocity. Network function. Two-port network: Z-parameters, Y-parameters, h-parameters & ABCD parameters. Definition of graph & tree of a network. Cut-set matrix. | 10 |
| **Week 10-12** | [A],[B] & [Q] matrices : Relationship among them, Tutorial -1, Tutorial-2 | 10 |
| | **Total No. of Hours** | **40** |
| **Textbooks** | 1. D. Roy Choudhary, Network and Systems, Wiley Eastern,. | |
| **References** | 1. Van Valkenburg M E, Network Analysis 3rd Edition, Prentice Hall.<br>2. Van Valkenberg M.E., Introduction to Modern Network Synthesis, John Wiley and Sons.<br>3. Franklin. F. Kuo, Network Analysis and Synthesis, John Wiley & sons.<br>4. Hayt, Kimmerly, Engineering Circuit Analysis, McGraw Hill.<br>5. Desoer C.A. & Kuh E.S., Basic Circuit Theory, McGraw-Hill.<br>6. Ryder J.D., Networks, Lines and Fields, Prentice Hall.<br>7. B. P. Lathi, Linear Systema and Signals, Oxford University Press. | |

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|---|---|
| | 8. DeCarlo, R.A., & Lin, "Linear Circuit Analysis", 2 nd Edition, OUP Indian Edition 2003.<br>9. Mahmood Nahvi, Joseph, A. Edminister, "Theory and Problems of Electric Circuits – Schaum's outline series", McGraw Hill.<br>10. Donald E. Scott, "An Introduction to Circuit analysis: A System Approach" McGraw Hill Book Company.<br>11. A.Chakrabarti,"Circuit Theory" Dhanpat Rai & Co. |


**SEMESTER V**

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SET/EI/BT/C501 | Power Systems | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EI/BT/C501 MOOC | Power Systems Analysis* | - | - | - | - | - | - | - | 100 | |
| 2 | SET/EI/BT/C502 | Control Systems | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EI/BT/C502 MOOC | Control Systems* | - | - | - | - | - | - | - | 100 | |
| 3 | SET/EI/BT/C503 | Industrial Instrumentation | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 4 | SET/EI/BT/C504 | Power Electronics | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | SET/EI/BT/C504 MOOC | Power Electronics* | - | - | - | - | - | - | - | 100 | |
| 5 | | PE-01 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 6 | SET/EI/BT/C506 | Power Systems Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 7 | SET/EI/BT/C507 | Control Systems Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 8 | SET/EI/BT/C508 | Industrial Instrumentation Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 9 | SET/EI/BT/C509 | Power Electronics Lab | - | - | 2 | 30 | - | 30 | 70 | 100 | 1 |
| 10 | SET/HS/BT/H510 | Foundations of Yoga (**HSMC) | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| | | | | | | | | | | **Total** | 22 |

*MOOC Course, ** Humanities and Social Sciences including Management courses.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 01 (PE-01)** | 1 | SET/EI/BT/E505 (i) | Electrical Drives |
| | 2 | SET/EI/BT/E505 (ii) | Line Commutated and Active PWM Rectifiers |
| | 3 | SET/EI/BT/E505 (iii) | Electrical Machine Design |

## MOOC's/SWAYAM Courses introduced in Fifth Semester:

| SET/EI/BT/C501MOOC. POWER SYSTEM ANALYSIS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Structure Of Power System and Few Other Aspects, Resistance, Inductance, and Capacitance of Transmission Lines, Power System Components and Per Unit System | 10 |
| **Week 4-6** | Characteristics and Performance of Transmission Lines, Load Flow Analysis | 10 |
| **Week 7-9** | Optimal System Operation, Symmetrical Fault. | 10 |
| **Week 10-12** | Symmetrical Components, Unbalanced Fault Analysis, Power System Stability. | 10 |
| | **Total No. of Hours** | **40** |
| **Textbooks** | 1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994. | |
| **References** | 2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.<br>3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.<br>4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.<br>5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012. | |

| SET/EI/BT/C502MOOC. CONTROL SYSTEMS | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Introduction to Control, Classi_cation of Dynamic Systems, Closed Loop Control System with Feedback, Mathematical Preliminaries – Complex Variables, Laplace Transform. Standard Inputs, Free and Forced Response, Transfer Function, Poles and Zeros. esponse to various Inputs, E_ect of Poles, Notion of Bounded Input Bounded Output (BIBO) stability. | 10 |
| **Week 4-6** | Effect of Zeros, Closed Loop Transfer Function, Dynamic Performance Speci_cation, First | 10 |

| | | |
|---|---|---|
| | Order Systems. Second Order Systems, Unit Step Response of Underdamped Second Order Systems, Concepts of Rise<br>Time, Peak Time, Maximum Peak Overshoot and Settling Time. Controllers – Proportional (P), Integral (I) and Derivative (D) Blocks, Examples of PID controller design. | |
| **Week 7-9** | Routh's Stability Criterion, Use in Control Design, Incorporation of Performance Specifications in Controller Design, Analysis of Steady State Errors. Root Locus and its Application in Control Design. Frequency Response, Bode Plots, Nyquist Plots. | 10 |
| **Week 10-12** | Nyquist Stability Criterion, Relative Stability – Gain and Phase Margins. Control System Design via Frequency Response – Lead, Lag and Lag-Lead Compensation. Case Studies. | 10 |
| | **Total No. of Hours** | **40** |
| **Textbooks** | 1. I. G. Nagrath, M. Gopal, "Control Systems". Wiley, New York, 1983. | |
| **References** | 1. K. Ogata, "Modern Control Engg". PHI publications.<br>2. B. C. Kuo, "Automatic Control Systems". Prentice. Hall. | |

| **SET/EI/BT/C504MOOC. POWER ELECTRONICS** | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Introduction to Power Electronics, Power devices : Diodes, SCRs, GTO, BJT, MOSFET, IGBT- Characteristics, working, selection and protection, AC-DC converter: half wave & full wave; uncontrolled, semi-controlled & fully controlled; single-phase and three-phase | 10 |
| **Week 4-6** | Assignment No. 2 and 3 on single-phase and three-phase converters and simulations, AC-AC converters: AC voltage controllers and cycloconverters, Non-isolated DC-DC converters: Buck, Boost, Buck-boost & Cuk | 10 |
| **Week 7-9** | Isolated DC-DC converters, DC-AC Inverters: Single-phase and three-phase, modulation techniques, Current Source inverter | 10 |
| **Week 10-12** | Applications of Power Electronics in Generation, Transmission, Distribution & utilization sectors, Assignment No. 6 on Isolated DC-DC converters: Problems and simulation, Assignment No. 7&8 on DC-AC inverters (single-phase and three-phase): problems and simulation | 10 |
| | **Total No. of Hours** | **40** |
| **Textbooks** | 1. P.S.Bhimra, Power Electronics. Khanna Publication, Delhi.<br>2. M.H. Rashid, Power Electronics. P.H.I Private Ltd. New Delhi, | |
| **References** | 1. N. Mohan, T.M. Undeland & W.P. Robbins, Power Electronics. John Wiley & Sons, Inc, 2003.<br>2. M.D. singh & K.B. Khanchandani, power electronics. Tata McGraw-Hill Education. | |

## .SEMESTER VIII

| S. No. | Code | Course Title | L | T | P | T.A | C.T | TOT | ESE | SUB. TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | PE-04 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 2 | | OE-04 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 3 | | OE-05 | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 3 |
| 4 | SET/EI/BT/C804 | Major Project | - | - | 16 | - | - | - | - | 100 | 8 |
| | | | | | | | | | | **Total** | 17 |

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

| | S. No. | Code | Course Title |
|---|---|---|---|
| **Professional Elective 04 (PE-04)** | 1 | SET/EI/BT/E801 (i) | Renewable Energy Engineering |
| | | SET/EI/BT/E801 (i)MOOC | Non-Conventional Energy Resources* |
| | 2 | SET/EI/BT/E801 (ii) | Electrical Distribution System |
| | 3 | SET/EI/BT/E801 (iii) | Control Systems Design |
| | 4 | SET/EI/BT/E801 (iv) | Switchgear and Protection |

*MOOC Course,

| **Open Elective 04 and 05 (OE-04, OE-05)** | S. No. | Code | Course Title |
|---|---|---|---|
| | 1 | SET/EI/BT/E802 (i) | Data Communication and Networking |
| | | SET/EI/BT/E803 (i) | |

| | | | |
|---|---|---|---|
| | 2 | SET/EI/BT/E802 (ii) | Virtual Instrumentation |
| | | SET/EI/BT/E803 (ii) | |
| | 3 | SET/EI/BT/E802 (iii) | Smart Grid Technology |
| | | SET/EI/BT/E803 (iii) | |
| | 4 | SET/EI/BT/E802 (iv) | Mobile Communication and Networks |
| | | SET/EI/BT/E803 (iv) | |

## MOOC's/SWAYAM Courses introduced in Eighth Semester:

| SET/EI/BT/E801 (i)MOOC. NON-CONVENTIONAL ENERGY RESOURCES | | |
|---|---|---|
| **Module Name** | **Content** | **No. of Hrs.** |
| **Week 1-3** | Scale of quantities, Impact of current energy usage, Conventional sources of energy<br>Overview of non-conventional energy resources, Consumption by sector<br>Solar energy incident on earth, solar spectrum | 10 |
| **Week 4-6** | Overview of solar energy technologies, Solar Thermal devices<br>Solar Photovoltaic devices, Performance and durability of solar devices<br>Wind energy, technology and geographical aspects | 10 |
| **Week 7-9** | Geothermal and Biomass<br>Battery basics, types<br>Testing, performance of batteries | 10 |
| **Week 10-12** | Fuel cell types, Fuel processing, concept to product.<br>Characterization and durability of fuel cells<br>Flywheels and super capacitors | 10 |
| | **Total No. of Hours** | **40** |
| **Textbooks** | 1. D. P. Kothari, "Renewable Energy Resources", PHI Publications. | |
| **References** | 1. G. D. Rai, "Non- conventional sources of energy", Khanna Publishers, Delhi. | |

Prof. R. S. Rana

Prof. S.C. Bhatt

Mr. G. S. Kathait

Prof. V. M. Mishra

Prof. N.S. Panwar