College Calendar 2021-22

Department of
Electrical & Electronics Engineering

Syllabus
of
4th Year
VII & VIII SEMESTER
Department of
Electrical & Electronics Engineering

College Calendar 2021-22
मातेव रक्षति पितेव हिंते नियुक्तें
कानेव चापि समायपनीय खेदमू।
लक्ष्मी तनोति वितनोति च दिश्यु कीति
किं ििं न साधयति कल्यालेस विद्या॥

लक्ष्मीं रक्षीं माता आळू नियुक्तीं
कारतां च नंक्रमावर्नं विद्या॥

विश्वास माता की तरह पालन करती है, वाप के तरह हिंसक मार्ग में ही ले लेता है। पाली की तरह हमारा दुःख दूर करता है। मन को सलाम देता है, धन देती है, दिशाओं में कीति भूलाती है। कल्यालेंकी की तरह वह सब कामनायें पूरी करती है।

Do you know in how many ways the 'Knowledge' serves his master? Like mother it protects, like father it teaches and guides, like wife, provides all kinds of happiness after destroying all sorrows, it brings wealth from every corner and spreads the fame in all direction. Like 'Kalpalatha' knowledge offers everything to human being whatever he wishes.
COLLEGE CALENDAR
2021-22
(VII & VIII Semester)
Vision Statement

Pursuing Excellence, Empowering people, Partnering in Community Development

Mission Statement

To develop N.M.A.M. Institute of Technology, Nitte, as Centre of Excellence by imparting Quality Education to generate competent, Skilled and Humane Manpower to face emerging Scientific, Technological, Managerial and Social Challenges with Credibility, Integrity, Ethics and Social Concern.
In Memorium

Late Nitte Mahalinga Adyanthaya
Our Founder

Late Justice K. S. Hegde
1909-1990
SRI N. VINAYA HEGDE
President, Nitte Education Trust
Chancellor, Nitte (Deemed to be University), Mangaluru
<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of the Faculty</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dr. Niranjan N. Chiplunkar</td>
<td>Principal</td>
</tr>
<tr>
<td>2</td>
<td>Mr. Yogeesh Hegde</td>
<td>Registrar</td>
</tr>
<tr>
<td>3</td>
<td>Dr. Shrinivasa Rao B. R.</td>
<td>Vice Principal / Controller of Examinations / Professor</td>
</tr>
<tr>
<td>4</td>
<td>Dr. I. Ramesh Mithanthaya</td>
<td>Vice Principal / Dean (Academics) / Professor</td>
</tr>
<tr>
<td>5</td>
<td>Dr. Sudekh Bekal</td>
<td>Dean (R&amp;D)/Professor</td>
</tr>
<tr>
<td>6</td>
<td>Dr. Rajesh Shetty K.</td>
<td>Dean (Admissions) / Professor</td>
</tr>
<tr>
<td>7</td>
<td>Dr. Subrahmany Bhat K.</td>
<td>Dean (Student Welfare) / Professor</td>
</tr>
<tr>
<td>8</td>
<td>Dr. Nagesh Prabhu</td>
<td>PG Coordinator/Professor</td>
</tr>
<tr>
<td>9</td>
<td>Dr. Srinath Shetty K.</td>
<td>Resident Engineer/Professor</td>
</tr>
</tbody>
</table>

**HEADS OF DEPARTMENTS**

1. Prof. Shalini K. Sharma
   Counseling, Welfare, Training & Placement

2. Dr. Arun Kumar Bhat
   Civil Engg.

3. Dr. Jyothishetty
   Computer Science & Engg.

4. Dr. Karthik Pai B. H.
   Information Science & Engg.

5. Dr. Srinivas Pai P.
   Mechanical Engg.

6. Dr. KV SSSS Sairam
   Electronics & Communication Engg.

7. Dr. Suryanarayana K.
   Electrical & Electronics Engg.

8. Dr. Ujwal P.
   Biotechnology Engg.

9. Dr. Udaya Kumar Shenoy
   Computer & Communication Engg.

10. Dr. Sharada Uday Shenoy
    Artificial Intelligence & Machine Learning Engg.

11. Dr. Muralidhara K.
    Robotics & Artificial Intelligence Engg.

12. Dr. Kumudakshi
    Mathematics

13. Dr. Shobha R. Prabhu
    Physics

14. Dr. Shivaprasad Shetty M.
    Chemistry

15. Mrs. Rashmi D. Hegde
    Humanities

16. Dr. Surendra Shetty
    MCA

**INCHARGE OF INSTITUTION’S RESPONSIBILITIES**

1. Dr. Gururaj Upadhayaya
   Workshop Supdt.

2. Dr. Narasimha Bailkeri
   1st year Coordinator

3. Dr. Venkatesh Kamath
   Deputy Controller of Examination

4. Dr. Janardhan Nayak
   Co-ordinator, Red Cross Unit

5. Mr. Srinivas Nekkar
   NCC Officer

6. Mr. Krishnaraja Joisa
   Public Relations Officer

7. Dr. Jnaneshwar Pai Maroor
   Co-ordinator, Alumni

8. Sri. Shekar Poojari
   Student Welfare Officer
ENTREPRENEURSHIP DEVELOPMENT CELL
1. Dr. Ramakrishna B. Professor/EDC- Incharge
2. Mrs. Geetha Poojarthi Co-ordinator

DEPARTMENT OF TRAINING & PLACEMENT
1. Mr. Bharath G. Kumar Lead Placements

DEPARTMENT OF MATHEMATICS
1. Dr. Shashirekha B. Rai Professor
2. Dr. P. Shankaran Professor
3. Dr. Kumudakshi Asso. Professor/ HoD
4. Dr. Sharad M. Hegde Asst. Professor Gd III
5. Dr. Vasanth K. R. Asst. Professor Gd III
6. Mrs. Ambika N. Asst. Professor Gd I
7. Mrs. Vinaya Acharya Asst. Professor Gd I
8. Mrs. Anitha D. Bayar Asst. Professor
9. Mrs. Bhavya K. Asst. Professor
10. Ms. Chaithra K. Asst. Professor
12. Mrs. Sharmila Asst. Professor
13. Mrs. Anjana Pai K. Asst. Professor
14. Mrs. Soumya Asst. Professor
15. Mrs. Smitha G. V. Asst. Professor

DEPARTMENT OF PHYSICS
1. Dr. K. B. Vijaya Kumar Professor
2. Dr. Sathyajith K. T. Asso. Professor
3. Dr. Manjunath K. B. Asso. Professor
4. Dr. Shobha R. Prabhu Asso. Professor / HoD
5. Dr. Nagaraja B. S. Asst. Professor Gd III
6. Dr. Raghavendra Bairy Asst. Professor Gd III
7. Dr. Shyam Prasad K. Asst. Professor Gd III

DEPARTMENT OF CHEMISTRY
1. Dr. Janardhana Nayak Professor
2. Dr. Ramesh Bhat Asso. Professor
3. Dr. Shivaprasad Shetty M. Asst. Professor Gd III/HoD
4. Dr. Aarti S. Bhat Asst. Professor Gd III
5. Dr. Subrahmanya Ishwar Bhat Asst. Professor Gd III
6. Mr. Sarvajith M. S. Asst. Professor
DEPARTMENT OF HUMANITIES
1. Dr. Ramakrishna B. Professor
2. Mrs. Rashmi D. Hegde Asso. Professor/HoD
3. Dr. Vishwanatha Asso. Professor
4. Dr. Jnaneshwar Pai Maroor Asst. Professor Gd III
5. Dr. Joy Elvin Martis Asst. Professor Gd III
6. Mrs. Shyla D. Mendonca Asst. Professor Gd II
7. Ms. Sonia Lobo Asst. Professor Gd I
8. Mr. Srinivas Nekkar Asst. Professor
9. Mrs. Sudeeksha S. Pai Asst. Professor

OFFICE SECTION HEADS
1. Mr. Keshava Mugeraya Sr. Supdt., Academic Section/ Purchase In-Charge
2. Mrs. Suneetha R. Shetty Sr. Supdt., Administrative Section
3. Mr. Suresh Achar Sr. Supdt., Stores
4. Mrs. Jayashree Sr. Programmer
5. Mrs. Shailaja V. Shetty Supdt., Accounts Section
6. Sri. Sudhakar K. Incharge Librarian

SECURITY DEPARTMENT
1. Mr. Hirianna Suvarna S. Security Supervisor

SPORTS DEPARTMENT
1. Sri. Shyam Sundar M. P.E.D
2. Sri. Ganesh Poojary P.E.D
3. Ms. Sowjanya M. P.E.I
4. Mr. Ravi Prakash C. Anpur Basket Ball Coach

HOSTEL WARDENS
1. Dr. Veena Devi S.V Chief Warden, NET Ladies Hostels, Nitte
2. Dr. Vishwanatha Chief Warden, NET Gents Hostels, Nitte

HOSTEL SUPERINTENDENT / MANAGER
1. Mr. John D’Souza Sr. Manager, Gents Main Hostel
2. Mr. Francis D’Souza Hostel Manager, Gents Main Hostel
3. Mr. Rajesh Ballal Supervisor, Gents PG Hostel
4. Mrs. Gayathri Kamath Supdt. Ladies PG Hostel
5. Mrs. Chethana Sharma Supdt.Ladies Main Hostel
6. Mrs. Hema S. Hegde Supdt., Hostel Office
REGULATIONS
2021-22
(Applicable for admission batch 2018-19 onwards)

COMMON TO ALL B.E. (CREDIT SYSTEM)
DEGREE PROGRAMMES
CONTENTS

REGULATIONS

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11. VERTICAL PROGRESSION
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14. AWARD OF DEGREE
15. GRADUATION REQUIREMENTS AND CONVOCATION
16. AWARD OF PRIZES, MEDALS, CLASS AND RANKS
17. CONDUCT AND DISCIPLINE
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19. LISTS OF MAJOR SCHOLARSHIPS
REGULATIONS COMMON TO ALL B.E. (CREDIT SYSTEM) DEGREE PROGRAMMES OF
NMAM INSTITUTE OF TECHNOLOGY, NITTE
Karkala, Udupi Dist., Karnataka

1. INTRODUCTION

1.1 The general regulations are common to all B.E. (Credit System) Degree Programmes conducted at the NMAMIT, Nitte Campus and shall be called “NMAMIT Regulations”.

1.2 The provisions contained in this set of regulations govern the policies and procedures on the Registration of students, imparting Instructions of course, conduct of the examination and evaluation and certification of student’s performance and all amendments related to the said Degree programme(s).

1.3 This set of Regulations, on approval by the Academic Council and Governing Council, shall supersede all the corresponding earlier sets of regulations of the BE Degree program (of VTU) along with all the amendments thereto, and shall be binding on all students undergoing the Graduate Degree Programme(s) (Credit System) conducted at the NMAMIT, Nitte with effect from its date of approval. This set of Regulations, may evolve and get modified or changed through appropriate approvals from the Academic Council / Governing Council from time to time, and shall be binding on all stake holders (The Students, Faculty, Staff of Departments of NMAMIT, Nitte). The decision of the Academic Council/ Governing Council shall be final and binding.

1.4 In order to guarantee fairness and justice to the parties concerned in view of the periodic evolutionary refinements, any specific issues or matters of concern shall be addressed separately, by the appropriate authorities, as and when found necessary.

1.5 The Academic Council may consider any issues or matters of Concern relating to any or all the academic activities of NMAMIT courses for appropriate action, irrespective of whether a reference is made here in this set of Regulations or otherwise.

1.6 The course shall be called Bachelor of Engineering course abbreviated as B.E. (Subject of specialization) – Credit System.

1.7 DURATION OF THE COURSE
(a) The course shall extend over a period of total duration of 4 years.
(b) Each year shall have the following schedule with 5 ½ days a week.

Suggested Break down of Academic Year into Semesters
1. No. of Semesters / Year Three; Two being Main semesters (odd, even) and one being a supplementary semester; after 2 main semesters.

(Note: Supplementary semester is primarily to assist weak and/or failed students through make up courses. However, Autonomous Colleges may use this semester to arrange Add-On courses for other students and/or for deputing them for practical training elsewhere.)

2. Semester Duration

<table>
<thead>
<tr>
<th></th>
<th>Main semester (odd, even) each 19 Weeks; Supplementary Semester 8 Weeks</th>
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3. Academic Activities

<table>
<thead>
<tr>
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<th>Main Semester</th>
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</thead>
<tbody>
<tr>
<td>(Weeks):</td>
<td>Registration of Courses &amp; Course Work (16.0)</td>
</tr>
<tr>
<td></td>
<td>Examination Preparation and Examination (3.0)</td>
</tr>
<tr>
<td></td>
<td>Total (19)</td>
</tr>
<tr>
<td></td>
<td>Supplementary Semester</td>
</tr>
<tr>
<td></td>
<td>Registration of Courses &amp; Course Work (5.0)</td>
</tr>
<tr>
<td></td>
<td>Examination Preparation and Examination (3.0)</td>
</tr>
<tr>
<td></td>
<td>Total (8)</td>
</tr>
<tr>
<td></td>
<td>Declaration of results: 2 weeks from the date of last examination</td>
</tr>
<tr>
<td></td>
<td>Inter- Semester Recess:</td>
</tr>
<tr>
<td></td>
<td>After each Main Semester (2)</td>
</tr>
<tr>
<td></td>
<td>Total Vacation: 10 weeks (for those who do not register for supplementary semester) and 4 weeks (for those who register for supplementary semester)</td>
</tr>
</tbody>
</table>

(Note: In each semester, there will be provision for students for Registration of courses at the beginning, dropping of courses in the middle and withdrawal from courses towards the end, under the advice of faculty member. These facilities are expected to enhance the learning capabilities of students, minimizing their chances of failure in courses registered and also ensure their better monitoring by Faculty Advisors).

A candidate shall be allowed a maximum duration of eight years from the first semester of admission to become eligible for the award of Bachelor Degree.

The calendar of events in respect of the course shall be fixed by the Senate from time to time, but preferably in line with the academic calendar of the VTU.

2. DEGREE PROGRAMMES

2.1 Undergraduate B.E. Degree Programmes are offered in the following disciplines by the respective programme hosting departments listed below:

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>i</td>
<td>Biotechnology Engineering (BT)</td>
</tr>
<tr>
<td>ii</td>
<td>Civil Engineering (CV)</td>
</tr>
<tr>
<td>iii</td>
<td>Computer Science &amp; Engineering (CS)</td>
</tr>
<tr>
<td>iv</td>
<td>Electronics &amp; Communications Engineering (EC)</td>
</tr>
</tbody>
</table>
v) Electrical & Electronics Engineering (EE)
vi) Information Science & Engineering (IS)

vii) Mechanical Engineering (ME)
viii) Artificial Intelligence and Machine Learning Engg. (AM)*
ix) Computer and communication Engineering (CC)*
x) Robotics and Artificial Intelligence Engineering (RA)*

Other teaching departments are –
i) Mathematics (MA)
ii) Physics (PH)
iii) Chemistry (CY)
iv) Humanities, Social Sciences and Management (HU)

2.2 The provisions of these Regulations shall be applicable to any new discipline* that may be introduced from time to time and appended to the above list.

3. REGISTRATION

3.1 Every student after consulting his Faculty Advisor in parent department shall register approved courses (core and elective) to earn credits for meeting the requirements of degree program at the commencement of each Semester on the days fixed for such registration and notified in the academic calendar. Students who fail to register on or before the specified date will have to pay a late fee. Such courses together with their grade and credits earned will be included in the grade card issued by the college at the end of each semester, like odd, even, supplementary and it forms the basis for determining the student’s performance in that semester.

3.2 Lower and Upper Limits for Course Credits Registered in a Semester Course Credit Assignment

All courses comprise of specific Lecture/Tutorial/Practical (L-T-P) schedule. The course credits are fixed based on the following norms.

Lecture / Tutorials / Practical:
i) One hour Lecture per week is assigned one Credit.
ii) 2-hour Tutorial session per week is assigned 1.0 Credit.
iii) 2-hour Lab. session per week is assigned 1.0 credit.

For example, a theory course with L-T-P schedule of 3-2-0 hours will be assigned 4.0 credits.

A laboratory practical course with L-T-P schedule of 0-0-2 hours will be assigned 1.0 credit.

Calculation of Contact Hours / Week – A Typical Example
### Typical Course Load per Semester

<table>
<thead>
<tr>
<th>No. of Courses</th>
<th>Credits / Course</th>
<th>Total Credits</th>
<th>Contact Hours per Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Lecture Courses</td>
<td>3:0:0</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2 Lec. cum Lab Courses</td>
<td>3:0:1</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>2 Lec. cum Tut. Courses</td>
<td>3:1:0</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>1 Lec. Tut. cum Lab Courses</td>
<td>1:1:1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10:2:2</strong></td>
<td><strong>25</strong></td>
<td><strong>31</strong></td>
</tr>
</tbody>
</table>

A student must register, as advised by Faculty Advisor, between a minimum of 16 credits and up to a Maximum of 28 credits.

#### 3.3 Mandatory Pre-Registration for higher semester

In order to facilitate proper planning of the academic activities of the Semester, it is necessary for the students to declare their intention to register for courses of higher semesters (3rd and above) at least two weeks before the end of the current semester choosing the courses offered by each department in the next higher semester which is displayed on the Department Notice Board at least 4 weeks prior to the last working day of the semester.

Registration to a higher semester is allowed only if the student fulfills the following conditions -

1. satisfied all the academic requirements to continue with the programme of studies without termination
2. cleared all Institute, hostel and library dues and fines, if any, of the previous semester
3. paid all required advance payments of the Institute and the hostel for the current semester
4. has not been debarred from registering on any specific grounds by the Institute.

#### 4. ADD / DROP / AUDIT options

##### 4.1 Registration of courses

Each student shall have to register for course work at the beginning of a semester within 2 to 3 days of commencement after discussing with subject teacher and under faculty advice. The permissible course load to be either average credits (=22) or to be within the limits of minimum (=16) and maximum (=28) credits.

##### 4.2 DROP-option

During a specified period at the middle of a semester student's performance in CIE is reviewed by the faculty advisor. Following poor performance by a student he/she can be facilitated to drop identified course(s) (up to the minimum credits specified for the semester). Such course(s) will not be mentioned in the Grade card. Such courses to be re-registered by these students and taken up for study at a later time.
4.3 Withdrawal from courses
During a specific period specified towards the end of the semester, student’s performance in CIE is reviewed by the Faculty advisors. Following poor performance by a student in identified course (s) he/she is advised to withdraw from such course(s) (up to the minimum credits specified for the semester) with mention in the Grade card (Grade ‘W’). Such courses to be re-registered by these students and taken up for study at a later time.

4.4 AUDIT-option
A student can register for courses for audit only, with a view to supplement his/her knowledge and/or skills. The student’s grades in such course(s) will have to be reflected in the grade card. However, CORE courses shall not be made available for audit. But these shall not be taken into account in determining the student’s academic performance in the semester. ‘U’ grade is awarded to such courses on satisfying the attendance requirements and CIE requirements. The candidate need not appear for SEE in such courses.

5. COURSE STRUCTURE:
5.1 Typical Breakdown for the B.E. Degree Curriculum:

<table>
<thead>
<tr>
<th>No.</th>
<th>Course Category</th>
<th>Credit Range</th>
<th>Credit Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Basic Sciences (BSC)</td>
<td>24-30</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Engineering Sciences (ESC)</td>
<td>15-20</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Humanities, Social Sciences and Management</td>
<td>7-10</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Professional Courses (PCC) – core</td>
<td>70-90</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Professional Courses (PEC) – elective</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Open Elective Courses (OE)</td>
<td>06</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Project Work (PROJ)</td>
<td>16</td>
<td>(VI – 2, VII-2, VIII-12)</td>
</tr>
<tr>
<td>8.</td>
<td>Seminar on Current Topic</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Internship</td>
<td>03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mandatory Learning courses</td>
<td>Non-Credit</td>
<td></td>
</tr>
</tbody>
</table>

Note: Student can register between 16 to 28 credits per semester
Total Credits to be earned: 175

5.2 The Department Undergraduate Committee (DUGC) will discuss and recommend the exact credits offered for the programme for the above components ‘a’ to ‘g’, the semester wise distribution among them, as well as the syllabi of all undergraduate courses offered by the department from time to time before sending the same to the Board of Studies (BOS). The BOS will consider the proposals from the departments and make recommendations to the senate for consideration and approval.

5.3 The earned Credit Requirement for the B.E. Degree is 175.
Degree is awarded by prescribing the total number of credits to be earned, rather than by using the program duration, giving flexibility to student to plan their career.
5.4 Mandatory Learning Courses

These are courses that must be completed by the student at appropriate time or at his convenience. The 'PP' grade is awarded for a Pass in the course and 'NP' grade is awarded for a Fail in the course. In case 'NP' grade is awarded, the student has to re-register for the same course wherein he has no alternative options. However, he/she can opt for other courses if he/she has been provided with multiple options.

The 'PP' and 'NP' grades do not carry grade points and hence not included in the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) computations. However such non-credit mandatory courses are required to be included in the students’ performance record (transcript) with Pass or Fail (PP or NP).

Courses that come under this category are the following.

Moral and Ethical Values, Communication skills, Entrepreneurship Development Programme, Environmental issues, Constitution of India, Proficiency in a Language etc.

Such courses will not carry any credits for the award of degree, but a pass in each of such course during the programme shall be a necessary requirement for the student to qualify for degree award.

5.5 PROJECT

i) Project work at 8th semester shall be completed batch wise. The batch shall consist of a maximum of 4 students.

ii) Project viva-voce examination shall be conducted individually.

5.6 ELECTIVES

i) A candidate shall take electives in each semester from groups of electives, commencing from 5th semester.

ii) The minimum number of students to be registered for any Elective offered shall not be less than ten.

iii) A candidate shall opt for his/her choice of electives and register for the same if pre-registration is not done, at the beginning of each of 5th, 6th, 7th and 8th semesters. The candidate is permitted to opt for change of elective within 15 days from the date of commencement of the semester as per the academic calendar of the college.

6. ATTENDANCE REQUIREMENT:

6.1 Each semester is considered as a unit and the candidate has to put in a minimum attendance of 85% in each subject with a provision of condoning 10% of the attendance by Principal for reasons such as medical grounds, participation in University level sports, cultural activities, seminars, workshops and paper presentation.

6.2 The basis for the calculation of the attendance shall be the period of term prescribed by the College by its calendar of events. For the first semester students, the same is reckoned from the date of admission to the course (as per CET/COMED-K or Management allotment).

6.3 The students shall be informed about their attendance position in the first week of every month by the College so that the students shall be cautioned to make up the shortage.

6.4 A candidate having shortage of attendance (<75%) in any course(s) registered shall not be allowed to appear for SEE of such course(s). Such students will be awarded 'N' grade in these courses.

He/she shall have to repeat those course(s). Such students shall re-register for the same
course(s) core or elective, as the case may be when the particular course is offered next either in a main (odd/even) or supplementary semester.

6.5 Attendance in CIE and SEE: Attendance at all examinations both CIE and SEE of each course registered shall be compulsory and there shall not be any provision for re-examinations. Any student against whom any disciplinary action is pending shall not be permitted to attend any SEE in that semester.

7. WITHDRAWAL FROM THE PROGRAMME

7.1 Temporary Withdrawal

a) A student who has been admitted to a degree programme of the college may be permitted once during the course to withdraw temporarily, for a period of one semester, on the grounds of prolonged illness or grave calamity in the family etc., provided –

i) The student applies to the College within 6 weeks of the commencement of the college stating fully the reasons for withdrawal together with supporting documents and endorsement from his parent/guardian.

ii) The College is satisfied about the genuineness of the case and that even by taking into account the expected period of withdrawal, the student has the possibility to complete the programme requirements (175 credits) within the time limits specified by the university.

iii) The student does not have any dues or demands at the College / University including tuition and other fees as well as library material.

iv) A student availing of temporary withdrawal shall be required to pay such fees and/or charges as may be fixed by the college until such time as his/her name appears on the Student’s roll list. The fees/charges once paid shall not be refunded.

v) A student will be entitled to avail the temporary withdrawal facility only once during his/her studentship. However, any other concession for the concerned student shall have to be approved by the academic council.

7.2 Permanent Withdrawal

Any student who withdraws admission before the closing date of admission for the Academic Session is eligible for the refund of the deposits only. Fees once paid will not be refunded on any account.

Once the admission for the year is closed, the following conditions govern withdrawal of admissions.

(a) A student who wants to leave the College for good, will be permitted to do so (and take Transfer Certificate from the College, if needed), only after remitting the Tuition fees as applicable for all the remaining semesters and clearing all other dues if any.

(b) Those students who have received any scholarship, stipend or other forms of assistance from the College shall repay all such amounts.

(c) The decision of the Principal of the College regarding withdrawal of a student is final and binding.

8. EVALUATION SYSTEM

8.1 The Academic Performance Evaluation of a student shall be according to a Letter Grading System, based on the Class Performance Distribution.
8.2 The Letter grades S, A, B, C, D, E, F indicate the level of academic achievement, assessed on a decimal (0-10) scale.

8.3 The Letter grade awarded to a student in a course, for which he has registered shall be based on his performance in quizzes, tutorials, assignments etc., as applicable, in addition to two mid-semester examinations and one semester end examination. The distribution of weightage among these components may be as follows.

Semester End Examination (SEE) : 50% (50 marks)
Continuous Internal Evaluation (CIE) : 50% (50 marks)
i) Quizzes, Tutorials, Assignments,
Seminars, mini projects, tutorials etc. : 10 marks
ii) Mid-semester Examination : 40 marks

Any variation, other than the above distribution, requires the approval of the pertinent DUGC and Academic Council.

8.4 The letter grade awarded to a student in a 0-0-P (Practical) course, is based on an appropriate continuous evaluation scheme that the course instructor shall evolve, with the approval of the pertinent DUGC and the performance in SEE held on specified period in a semester.

8.5 The course Instructor shall announce in the class and/or display at the Faculty door/website the details of the Evaluation Scheme, including the distribution of the weightage for each of the components and method of conversion from the raw scores to the letter-grades within the first week of the semester in which the course is offered, so that there are no ambiguities in communicating the same to all the students concerned.

8.6 Passing standards

<table>
<thead>
<tr>
<th>Evaluation Method</th>
<th>Passing Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sessional (CIE)</td>
<td>Score: ≥40% (≥20 marks)</td>
</tr>
<tr>
<td>Terminal (SEE)</td>
<td>Score: ≥40% (≥20 marks)</td>
</tr>
</tbody>
</table>

i) Project work evaluation: The evaluation of CIE of the project work shall be based on the progress of the student in the work assigned by the project supervisor, periodically evaluated by him/her together with a Department committee constituted for this purpose. Seminar presentation, project report and final oral examination conducted by project evaluation committee at the department level shall form the SEE of the project work.

ii) In the case of other requirements, such as, seminar, industrial internship, field work, comprehensive viva voce, if any, the assessment shall be made as laid down by the Academic council.

iii) There shall be no re-examination for any course in the credit system.

However, students

- who have abstained from attending CIE or SEE without valid reasons (‘N’ grade), or
- who have failed (‘F’ grade) to meet the minimum passing standards prescribed for CIE and/or SEE, or
- who have been detained for want of attendance, or
- who have withdrawn (‘W’ grade),
- who have dropped any course
shall be required to re-register for such course(s) and go through CIE and SEE again and obtain a grade equal to or better than E in each case. While such students should re-register for same course(s) if core, they can re-register for alternative course(s) from among the elective courses, as the case may be. The re-registration shall be possible when the particular course is offered again either in a main (Odd/Even) or a supplementary semester.

8.7 i) Grade point scale for absolute grading

<table>
<thead>
<tr>
<th>Level</th>
<th>Out Standing</th>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Average</th>
<th>Poor</th>
<th>Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Points</td>
<td>10</td>
<td>09</td>
<td>08</td>
<td>07</td>
<td>06</td>
<td>04</td>
<td>00</td>
</tr>
<tr>
<td>Score (Marks)</td>
<td>≥ 90</td>
<td>&lt; 90 - ≥80</td>
<td>&lt; 80 - ≥70</td>
<td>&lt; 70 - ≥60</td>
<td>&lt; 60 - ≥50</td>
<td>&lt; 50 - ≥40</td>
<td>&lt; 40</td>
</tr>
</tbody>
</table>

ii) The grade points given above help in the evaluation of credit points earned by the student in a course as the credit points are equal to the number of credits assigned to the course multiplied by the grade points awarded to the student in that course. This shall be used in arriving at the credit index of the student for that semester, as it is the sum total of all the credit points earned by the student for all the courses registered in that semester.

8.8 Earning of Credits

A student shall be considered to have completed a course successfully and earned the credits if he/she secures an acceptable letter grade in the range S-E. Letter grade ‘F’ in any course implies failure of the student in that course and no credits earned.

8.9 The Transitional Grades ‘I’, ‘W’ and ‘X’ would be awarded by the teachers in the following cases. These would be converted into one or the other of the letter grades (S-F) after the student completes the course requirements.

- Grade ‘I’: To a student having satisfactory attendance at classes and meeting the passing standard at CIE, but remained absent from SEE for valid & convincing reasons acceptable to the College, like:
  i) Illness or accident, which disabled him/her from attending SEE;
  ii) A calamity in the family at the time of SEE, which required the student to be away from the College;

- Students who remain absent for Semester End Examinations due to valid reasons and those who are absent due to health reasons are required to submit the necessary documents along with their request to the Controller of Examinations to write Make up Examinations within 2 working days of that particular examination for which he or she is absent, failing which they will not be given permission. This is admissible only for students who have more than 45 CIE marks.

- Grade ‘W’: To a student having satisfactory attendance at classes, but withdrawing from that course before the prescribed date in a semester under Faculty Advice

- Grade ‘X’: To a student having attendance ≥85% and CIE rating (90%), in a course but
SEE performance observed to be poor, which could result in a F grade in the course. (No ‘F’ grade awarded in this case but student’s performance record maintained separately).

8.10 Grade Card: Each student shall be issued a Grade Card (or Transcript) at the end of each semester. This will have a list of all the courses registered by a student in the semester, together with their credits, the letter grades with grade points awarded. Only those courses registered for credit and having grade points shall be included in the computation of the students performance like SGPA and CGPA and the courses taken for audit will not form part of this computation. The results of mandatory courses, which are of the non-credit type shall also be reflected in the Grade card as PP (for Passed) or NP (for not passed). Each UG student shall have to obtain the grade PP in each mandatory course to qualify for the Degree awarded by the university.

8.11 The Make Up Examination
The Make Up Examination facility would be available to students who may have missed to attend the SEE of one or more course(s) in a semester for valid reasons and given the ‘I’ grade; Also, students having the ‘X’ grade shall be eligible to take advantage of this facility. The makeup examination would be held as per dates notified in the Academic Calendar. However, it would be possible to hold a makeup examination at any other time in the semester with the permission of the Academic Council of the College. In all these cases, the standard of makeup examinations shall be same as the regular SEE for the course(s).

a) In the event of a student in the final semester failing in a Laboratory course and/or in CIE of a course, he/she could be given ‘I’ grade for the course. In such a case the concerned course instructor would have the possibility to grant the student extra time not exceeding 12 weeks for completing the course, with the concurrence of the Department/College. If no such extra time is sought/granted, the concerned student would have to re-register for the course in a succeeding semester and take steps to fulfill the requirements of the Degree.

b) All the ‘I’ and ‘X’ grades awarded to the students would be converted to appropriate letter grades after the make-up examinations. Any outstanding ‘I’ and ‘X’ grades after the last scheduled make-up examinations shall be automatically converted to ‘F’ grade.

c) All the ‘W’ grades awarded to the students would be eligible for conversion to the appropriate letter grades only after the concerned students re-register for these courses in a main/ supplementary semester and fulfill the passing standards for their CIE and (CIE+SEE).

9. EVALUATION OF PERFORMANCE
The overall performance of a student will be indicated by two indices:
SGPA; which is the Semester Grade Point Average, and CGPA which is the Cumulative Grade Point Average.

SGPA for a semester is computed as follows.

\[
SGPA = \frac{\sum (course \ credit) \times (Grade \ point))}{\sum (course \ credits)} \quad \text{(for all courses in that semester)}
\]

CGPA is computed as follows:

\[
CGPA = \frac{\sum (course \ credits) \times (Grade \ points))}{\sum (course \ credits)} \quad \text{(for all courses excluding those with F grades until that semester)}
\]

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10. COMMUNICATION OF GRADES

The SGPA and CGPA respectively, facilitate the declaration of academic performance of a student at the end of a semester and at the end of successive semesters. Both of them would be normally calculated to the second decimal position, so that the CGPA, in particular, can be made use of in rank ordering the students’ performance at a College. If two students get the same CGPA, the tie could be resolved by considering the number of times a student has obtained higher SGPA; But, if it is still not resolved, the number of times a student has obtained higher grades like S,A,B etc. could be taken into account.

11. VERTICAL PROGRESSION (PROMOTION / ELIGIBILITY TO HIGHER SEMESTERS)

11.1 There shall be no restriction for promotion from an odd semester to the next even semester, provided the student has fulfilled the attendance requirement.

11.2 A Student shall be declared fail if he / she

(i) Has not satisfied the CIE requirements of any Course/s.
(ii) Has not registered for the SEE even after satisfying the attendance and CIE requirements.

11.3 (A) Vertical Progression in case of students admitted to First year:

(a) Students having not more than four F grades in the two semesters of first year of the Programme shall be eligible to move to second year.

(a.1) Students having not more than four F grades in the four semesters of I and II year shall be eligible to move to III year.

(a.2) Students who have earned all the prescribed credits of I year, and having not more than four F grades in the four semesters of II and III year shall be eligible to move to IV year.

(B) Vertical Progression in case of Diploma students admitted to Second year (lateral entry):

(a) Students having not more than four F grades (excluding the Fail or pass status of Additional Mathematics I and II) in the two semesters of II year of the Programme shall be eligible to move to III Year.

(a.1) Students having not more than four F grades (excluding the Fail or pass status of Additional Mathematics I and II, if any) in the four semesters of II and III year shall be eligible to move to IV year.

(b) The mandatory non-credit Courses Additional Mathematics I and II prescribed at III and IV semesters respectively, to lateral entry Diploma holders admitted to III semester of B.E/B.Tech. Programmes shall attend the classes during the respective semesters to satisfy attendance and CIE requirements and to appear for the University examinations.

(b.1) In case, any student fails to satisfy the attendance requirement of the Courses Additional Mathematics I and II, he/she shall not be eligible to appear for the Semester End Examinations of that semester and shall not be permitted to take admission to next higher semester. The candidate shall be required to repeat that semester during the subsequent year.

(b.2) Students who have satisfied the attendance requirement but not the CIE requirements of the Courses Additional Mathematics I and II shall be permitted to register afresh and appear for SEE after satisfying the CIE requirements in the same Course/s (with or without satisfying the attendance requirement) when offered during subsequent semester/s.

(c) Completion of Additional Mathematics I and II shall be mandatory for the award of degree.
(C) Vertical Progression in case of B.Sc students admitted to Second year (Lateral entry):

(a) Students having not more than four F grades (excluding the Fail or pass status of Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme) in the two semesters of II year of the Programme shall be eligible to move to III year.

(a.1) Students having not more than four F grades (excluding the Fail or pass status of Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme, if any) in the four semesters of II and III year shall be eligible to move to IV year.

(b) The prescribed mandatory non-credit Courses Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme to lateral entry B. Sc holders admitted to III semester of B.E/B. Tech Programmes, shall attend the classes during the respective semesters to complete CIE and attendance requirements and to appear for the University examinations.

(b.1) In case, any student fails to satisfy the attendance requirement of the above said Courses; he/she shall not be eligible to appear for the Semester End Examinations of that semester and shall not be permitted to take admission to next higher semester. The candidate shall be required to repeat that semester during the subsequent year.

(b.2) Students who have satisfied the attendance requirement but not the CIE requirements of the above said Courses, shall be permitted to register afresh and appear for SEE after satisfying the CIE requirements in the same Course/s (with or without satisfying the attendance requirement) when offered during subsequent semester/s.

(c) Completion of Engineering Graphics and Elements of Civil Engineering and Mechanics shall be mandatory for the award of degree.

The Principal of each college shall make suitable arrangements in the timetable to facilitate the B. Sc students to attend the above mentioned courses to satisfy the CIE and attendance requirements and to appear for the University examinations.

11.4 Termination from the programme
A student shall be required to withdraw (discontinue) from the programme and leave the college on the following grounds.

i) Failure to secure a CGPA = 5.0 on three consecutive occasions.

ii) Failure to earn a credit of 175 (135 for lateral entry students) in 8 years (6 years for lateral entry students) of duration from the year of admission including the duration of temporary withdrawal (leave of absence).

iii) Absence from classes for more than six weeks at a time in a semester without leave of absence being granted by competent authorities.

iv) Failure to meet the standards of discipline as prescribed by the college from time to time.

12. AWARD OF CLASS
Sometimes, it would be necessary to provide equivalence of these averages, viz., SGPA and CGPA with the percentages and/or Class awarded as in the conventional system of declaring the results of University examinations. This can be done by prescribing certain specific thresholds in these averages for Distinction, First Class and Second Class. This can be seen from the following Table.
### Percentage Equivalence of Grade Points (For a 10-Point Scale)

<table>
<thead>
<tr>
<th>Grade Point</th>
<th>Percentage of Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.75</td>
<td>50 (second class)</td>
</tr>
<tr>
<td>6.25</td>
<td>55</td>
</tr>
<tr>
<td>6.75</td>
<td>60 (First class)</td>
</tr>
<tr>
<td>7.25</td>
<td>65</td>
</tr>
<tr>
<td>7.75</td>
<td>70 (Distinction)</td>
</tr>
<tr>
<td>8.25</td>
<td>75</td>
</tr>
</tbody>
</table>

Percentage = \((GPA - 0.75) \times 10\)

### 13. APPEAL FOR REVIEW OF GRADES

a. The entire process of evaluation shall be made transparent and the course instructor shall explain to a student why he/she gets whatever grade he/she is awarded, if and when required. A mechanism for review of grade is incorporated in the evaluation system. However, before appealing for such review, a student shall first approach the concerned course Instructor and then the concerned DUGC, with the request to do the needful; and only in situations where satisfactory remedial measures have not been taken, the student may then appeal to the Department Academic Appeals Boards (DAAB) before the date specified in Academic Calendar, by paying the prescribed fees.

b. The fee for such an appeal will be decided by the Senate from time to time. If the appeal is upheld by DAAB, then the fee amount will be refunded to the student.

### 14. AWARD OF DEGREE

#### 14.1 (1) B.E. Degree

a) Students shall be declared to have completed the Programme of B.E./B.Tech. degree and is eligible for the award of degree, provided the students have undergone the stipulated Course work of all the semesters under the Scheme of Teaching and Examinations and has earned the prescribed number of credits (175 credits for regular students registered for 4 year degree programmes & 135 for lateral entry students).

b) For the award of degree, a CGPA≥5.00 at the end of Programme shall be mandatory.

c) Completion of Additional Mathematics I and II, shall be mandatory for the award of degree to lateral entry diploma students.

d) Completion of Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme shall be mandatory for the award of degree to lateral entry B.Sc. graduates.

e) (i) Over and above the academic credits, every Day College regular student admitted to the 4 years Degree Programme and every student entering 4 years Degree Programme through lateral entry, shall earn 100 and 75 Activity Points respectively through AICTE Activity Point Programme for the award of degree. Students transferred from other Universities/Autonomous colleges under VTU to fifth semester are required to earn 50 Activity Points from the year of entry to VTU. The Activity Points earned shall be reflected on the student's eight semester Grade Card.

(ii) Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.

In case students fail to earn the prescribed activity Points before the commencement of 8th semester examinations, eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.
(2) B.E. (Honors) Degree

VTU, Belagavi has framed the guidelines for applying for the award of Bachelor of Engineering (Honors) degree.

These Regulations are applicable for the following students:

1. Admitted to I semester / I year from the academic year 2018-19 (i.e. USN XXX18XXXXX)
2. Admitted to III semester / II year from the academic year 2019-20 (i.e. USN XXX19XX4XX)
3. These Regulations are uniformly applicable to Affiliated, Autonomous and Constituent Colleges under VTU.

Eligibility criterion

(i) Students have to earn 18 or more additional credits through MOOCs.
(ii) Students shall register for this course from fifth semester onwards.
(iii) Students shall obtain a grade $\geq D$ in all the courses in first attempt only in all the semesters till 5th.
(iv) Students shall obtain CGPA of 8.5 and above at the end of fourth semester.
(v) For Diploma students, they shall complete Additional Mathematics I and II during 3rd and 4th semesters in first attempt only.

Requirements:

(i) Students shall maintain a grade $\geq D$ in all courses from 5th to 8th semester in ‘first attempt’ only.
(ii) Students not having CGPA greater than or equal to 8.5 at the end of the B.E. programme shall not be eligible for the award of Honors degree, even if they have satisfied the requirement of additional credits.
(iii) Students shall take up additional course work, other than the regular courses prescribed by the University from 5th to 8th semester from NPTEL and other platforms notified by the University and complete the same in any number of attempts with a final score (online assignments: 25 % + Proctored examination: 75 %) leading to the following certificates – ELITE (60 to 75 %) or ELITE + SILVER (76 to 89 %) or ELITE + GOLD ($\geq 90 %$) before closure of eighth semester as per the academic calendar.
(iv) Students shall be permitted to drop the registered course work (s) and select alternative course work (s) in case they cannot give proctored examination.
(v) Students have to take courses from the list of MOOCs approved by the University, which can be from NPTEL / SWAYAM / other platforms.
(vi) Students shall select courses in consultation with their Class Advisor, such that the content / syllabus of them are not similar to that of the core courses, professional electives or open electives, which the students may chose in the program.
(vii) Students shall earn the additional credits for these courses through MOOCs, by only appearing in person to the proctored examinations conducted by NPTEL / SWAYAM / other platform. The method of assessment shall be as per NPTEL online platform.
(viii) The Credit equivalence shall be as follows - 4 weeks of online course duration – 1 credit, 8 weeks of online course duration – 2 credits and 12 weeks of online course duration – 3 credits.
Registration:

(i) Any student meeting the eligibility criteria and interested to register for Honors degree qualification shall apply to the University through the Principal in the prescribed form along with the prescribed application fees within 15 working days after notification by the University.

(ii) The Registrar shall notify the registration of the student and it will be notified to the student and the student shall pay a one-time, non-refundable registration fees as prescribed by the University to confirm the registration.

Award of Honors Qualification:

(i) Students who successfully complete the MOOCs prescribed by the University and submit their E-certificate to the University through the Principal against the notification issued by the Registrar in time before the closure of eighth semester, as per the academic calendar shall be eligible for B.E. (Honors) degree. If a student does not submit the certificates in time on or before the last date, their request shall not be considered, even if they have earned the requisite number of credits.

(ii) The Honors degree shall be awarded only if the CGPA at the end of the B.E. programme is equal to or greater than 8.5.

(iii) A student who has earned the requisite number of credits and who has submitted the certificates in time and has been accepted by the University will get B.E. degree with Honors suffixed indicating recognition of higher achievement by the student concerned.

(iv) Further students fulfilling all the above requirements shall be entitled to receive their transcripts indicating both the achievement of the student concerned.

(v) The award of the Honors degree shall be recommended by the Academic Senate and approved by the Executive Council of the University.

14.2 (1) Noncompliance of CGPA \( \geq 5.00 \) at the end of the Programme

(a) Students, who have completed all the courses of the Programme but not having a CGPA \( \geq 5.00 \) at the end of the Programme, shall not be eligible for the award of the degree.

(b) In the cases of 14.2 (1) a, students shall be permitted to appear again for SEE in course/s (other than Internship, Technical seminar, Project (Mini and Main), and Laboratories) of any Semester/s without the rejection of CIE marks for any number of times, subject to the provision of maximum duration of the Programme to make up the CGPA equal to or greater than 5.00 for the award of the Degree.

(c) In case, the students earn improved grade/s in all the reappeared course/s, the CGPA shall be calculated considering the improved grade/s. If it is \( \geq 5.00 \), the students shall become eligible for the award of the degree. If CGPA <5.00, the students shall follow the procedure laid in 14.2 (1) b

(d) In case, the students earn improved grade/s in some course/s and the same or lesser than the previously earned pass grade/s in the other reappeared course/s, the CGPA shall be calculated considering the improved grade/s and the pass grades earned before the reappearance. If it is \( \geq 5.00 \), the students shall become eligible for the award of the degree. If CGPA<5.00, the students shall follow the procedure laid in 14.2 (1) b

(e) In case, the students earn improved grade/s in some courses and fail in the other reappeared course/s, the CGPA shall be calculated by considering the improved grade/s and
the previously earned pass grade/s of the reappeared course/s in which the students have failed. If it is ≥5.00, the students shall become eligible for the award of the degree. If CGPA < 5.00, the students shall follow the procedure laid in 14.2 (1) b

(f) In case, the students fail (i.e., earns F grade) in all the reappeared course/s, pass grade/s of the course/s earned by the students before reappearance shall be retained. In such cases, the students shall follow the procedure laid in 14.2 (1) b

(g) Students shall obtain written permission from the Registrar (Evaluation) to reappear in SEE to make up the CGPA equal to or greater than 5.00.

(2) Noncompliance of Mini-project
(a) The mini-project shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the mini-project shall be declared fail in that course and shall have to complete the same during subsequent University examinations after satisfying the Mini-project requirements. Also, mini-project shall be considered for eligibility to VII semester.

(3) Noncompliance of Internship
(a) All the students of B.E/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation. A University examination shall be conducted during VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail in that course and shall have to complete the same during subsequent University examinations after satisfy the internship requirements.

14.3 The maximum duration for a student for complying to the Degree requirements is 16 – semesters from the date of first registration for his first semester (8 years from the date of admission to first year, (12 semesters / 6 years from the date of admission for lateral entry student)).

15 **GRADUATION REQUIREMENTS AND CONVOCATION**

15.1 A student shall be declared to be eligible for the award of the degree if he/she has

a) Fulfilled “Award of Degree” Requirements
b) No Dues to the College, Departments, Hostels, Library, Central Computer Centre and any other centres
c) No disciplinary action pending against him/her.

15.2 The award of the degree must be recommended by the Senate

15.3 **Convocation**

Degree will be awarded for the students who have graduated during the preceding academic year. Students are required to apply for the Convocation along with the prescribed fees, after having satisfactorily completed all the degree requirements (refer ‘Award of Degree’) within the specified date in order to arrange for the award of the degree during convocation.

16 **AWARD OF PRIZES, MEDALS, CLASS & RANKS**

For the award of Prizes and Medals, the conditions stipulated by the Donor may be considered as per the statutes framed by the College for such awards.

Sometimes, it would be necessary to provide equivalence of these averages, viz., SGPA and CGPA with the percentages and/or Class awarded as in the conventional system of
declaring the results of University examinations. This can be done by prescribing certain specific thresholds in these averages for Distinction, First Class and Second Class as described in 12.

17 CONDUCT AND DISCIPLINE

17.1 Students shall conduct themselves within and outside the premises of the College in a manner befitting the students of an Institution of National Importance.

17.2 As per the order of Honorable Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.

17.3 The following acts of omission/ or commission shall constitute gross violation of the Code of Conduct and are liable to invoke disciplinary measures:
   a) Ragging.
   b) Lack of courtesy and decorum; indecent behaviour anywhere within or outside the campus.
   c) Willful damage or stealthy removal of any property/belongings of the College/Hostel or of fellow students/citizens.
   d) Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drugs.
   e) Mutilation or unauthorized possession of Library books.
   f) Noisy and unseemly behaviour, disturbing studies of fellow students.
   g) Hacking in computer systems (such as entering into other Person’s area without prior permission, manipulation and/or Damage of computer hardware and software or any other Cyber crime etc.).
   h) Plagiarism of any nature.
   i) Any other act of gross indiscipline as decided by the Senate from time to time.
   j) Use of Mobile in the college Academic area.
   k) Smoking in College Campus and supari chewing.
   l) Unauthorized fund raising and promoting sales.

Commensurate with the gravity of offence the punishment may be: reprimand, expulsion from the hostel, debarring from an examination, disallowing the use of certain facilities of the College, rustication for a specified period or even outright expulsion from the College, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.

17.4 For an offence committed in (i) a hostel (ii) a department or in a class room and (iii) elsewhere, the Chief Warden, the Head of the Department and the Dean (Academics), respectively, shall have the authority to reprimand or impose fine.

17.5 All cases involving punishment other than reprimand shall be reported to the Principal.

17.6 Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Controller of Examinations for taking appropriate action.

18. EARNING OF ACTIVITY POINTS FOR THE AWARD OF DEGREE

18.1 As per VTU guidelines, every students entering 4 year degree programme should earn 100 activity points & every students entering 4 year degree programme through Lateral Entry should earn 75 activity points for the award of the Engineering Degree.
18.2 The Activity Points earned will be reflected on the student’s eighth semester Grade Card.
18.3 The activities can be spread over the years (duration of the programme) any time during the semester weekends and holidays, as per the interest & convenience of the students from the year of entry to the programme.
18.4 Activity Points (non-credit) have no effect on SGPA/CGPA point.
18.5 In case students fail to earn the prescribed Activity Points, Eighth semester Grade Card shall be issued only after earning the required Activity Points.

Note: Students are required to be inside the examination hall, 20 minutes before the commencement of examination. This is applicable for all examinations (Semester end/Supplementary/makeup) henceforth. Students will not be allowed inside the examination hall after the commencement, under any circumstances.

*******
# LIST OF MAJOR SCHOLARSHIPS

<table>
<thead>
<tr>
<th>Applicable to</th>
<th>Types of scholarship</th>
<th>Method</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>For SC/ST Students</td>
<td><strong>Income : Below Rs.2,50,000/-</strong></td>
<td>Online application</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Income : Above Rs.2,50,000/- to Rs.10,00,000/-</strong></td>
<td></td>
<td>SSP</td>
</tr>
<tr>
<td>For Others</td>
<td><strong>Category I :</strong></td>
<td>Online application</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Category 2A, 3A, 3B, &amp; GM Income Below Rs.1,00,000/-</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Minority students Income Below Rs.2,50,000/-</strong></td>
<td>Online application</td>
<td>NSP &amp; SSP</td>
</tr>
<tr>
<td>Parents must have Beedi Id. Card</td>
<td><strong>Beedi Scholarship</strong></td>
<td>Online application</td>
<td>scholarships.gov.in or nsp.gov.in</td>
</tr>
<tr>
<td>1st year Students</td>
<td><strong>Central Sector Scholarship (MHRD)</strong></td>
<td>Online application</td>
<td>scholarships.gov.in or nsp.gov.in</td>
</tr>
<tr>
<td>1st year Students</td>
<td><strong>AICTE-Pragati, etc</strong></td>
<td>Online application</td>
<td><a href="http://www.aicte-india.org">www.aicte-india.org</a></td>
</tr>
</tbody>
</table>

1. Scholarship details will be published in the notice board near College Academic Section. Students must see the notice board and submit the application before due dates.
2. All SC/ST and Category I students who have not paid any fee in CET must apply for Fee concession or Scholarship. Otherwise they must pay the tuition fee and college fee.
3. The students, who are applying for any of the above scholarship through online, must submit the hardcopy with supporting documents (with attestation) to the academic section in time.
B. E. SYLLABUS

2021-22

ELECTRICAL & ELECTRONICS ENGINEERING
2018-22 Batch

VII & VIII SEMESTER

With Scheme of Teaching & Examination
<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of Faculty</th>
<th>Qualification</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dr. Nagesh Prabhu</td>
<td>Ph.D.</td>
<td>Professor</td>
</tr>
<tr>
<td>2.</td>
<td>Dr. Sathyendra Kumar</td>
<td>Ph.D.</td>
<td>Professor</td>
</tr>
<tr>
<td>3.</td>
<td>Dr. Suryanarayana K.</td>
<td>Ph.D.</td>
<td>Professor &amp; HOD</td>
</tr>
<tr>
<td>4.</td>
<td>Mr. K. Vasudeva Shettigar</td>
<td>M.Tech</td>
<td>Associate Professor</td>
</tr>
<tr>
<td>5.</td>
<td>Dr. Nayana Shetty</td>
<td>Ph.D.</td>
<td>Associate Professor</td>
</tr>
<tr>
<td>6.</td>
<td>Dr. Anitha Marina Colaco</td>
<td>Ph.D.</td>
<td>Associate Professor</td>
</tr>
<tr>
<td>7.</td>
<td>Mr. Naveen J.</td>
<td>M.Tech</td>
<td>Asst. Prof Gd III</td>
</tr>
<tr>
<td>8.</td>
<td>Mr. Pradeep Kumar</td>
<td>M.Tech (Ph.D.)</td>
<td>Asst. Prof Gd III</td>
</tr>
<tr>
<td>9.</td>
<td>Dr. Latha Shenoy</td>
<td>M.Tech (Ph.D.)</td>
<td>Asst. Prof Gd III</td>
</tr>
<tr>
<td>10.</td>
<td>Dr. CifhaCrecil Saldanha</td>
<td>Ph.D.</td>
<td>Asst. Prof Gd III</td>
</tr>
<tr>
<td>11.</td>
<td>Mr. Dinesh Shetty</td>
<td>M.Tech (Ph.D.)</td>
<td>Asst. Prof Gd III</td>
</tr>
<tr>
<td>12.</td>
<td>Mr. Mahabaleshwara Sharma K.</td>
<td>M.Tech</td>
<td>Asst. Prof Gd II</td>
</tr>
<tr>
<td>13.</td>
<td>Mrs. Raksha Adappa</td>
<td>M.Tech</td>
<td>Asst. Prof Gd II</td>
</tr>
<tr>
<td>14.</td>
<td>Mr. Girisha Joshi</td>
<td>M.Tech (Ph.D.)</td>
<td>Asst. Prof Gd II</td>
</tr>
<tr>
<td>15.</td>
<td>Mrs. Soumya Rani Mestha</td>
<td>M.Tech (Ph.D.)</td>
<td>Asst. Prof Gd II</td>
</tr>
<tr>
<td>16.</td>
<td>Mr. Gururaj K.</td>
<td>M.Tech</td>
<td>Asst. Prof Gd II</td>
</tr>
<tr>
<td>17.</td>
<td>Mr. Ravikiran Rao</td>
<td>M.Tech</td>
<td>Asst. Prof Gd II</td>
</tr>
<tr>
<td>18.</td>
<td>Md. Abdul Raheman</td>
<td>M.E</td>
<td>Asst. Prof Gd II</td>
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<tr>
<td>19.</td>
<td>Mrs. Swathi Hatwar H.</td>
<td>M.Tech</td>
<td>Asst. Prof Gd II</td>
</tr>
<tr>
<td>20.</td>
<td>Mrs. Palimaru Aparna</td>
<td>M.Tech</td>
<td>Asst. Prof Gd I</td>
</tr>
<tr>
<td>22.</td>
<td>Mr. Krishna Rao</td>
<td>M.Tech (Ph.D.)</td>
<td>Asst. Prof Gd I</td>
</tr>
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</table>
Vision
Pursuing excellence in Electrical & Electronics Engineering, creating a research environment to promote innovation and address global challenges.

Mission
- To equip students to face global challenges by excelling in professional career and higher education.
- To offer high quality graduate and post graduate programs in electrical & electronics engineering.
- To promote excellence in research, collaborative activities and contribute to social development with ethical values.

Programme Educational Objectives (PEO)
1. Excel in professional career and / or higher education by acquiring knowledge in mathematical, electrical, electronics and computer engineering principles.
2. Analyze real life problems, design electrical and electronics & multidisciplinary engineering systems and solutions that are socially acceptable.
3. Inculcate and exhibit ethical values, communication skills and provide supportive and leadership roles in their profession to emerge as excellent professionals and adapt to current trends by engaging in lifelong learning to promote research.
Programme Outcomes (PO)

At the end of B.E (E&E) program the students will have an ability to

P01 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

P02 Problem analysis: Identify, formulate, review research literature, analyze complex Electrical & Electronics Engineering problems and draw substantiated conclusions by applying the principles of mathematics, basic science and engineering sciences.

P03 Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

P04 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

P05 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

P06 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

P07 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

P08 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

P09 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

P010 Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports.
and design documentation, make effective presentations, and give and receive clear instructions.

P011 **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

P012 **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**Program Specific Outcomes (PSO)**

PS01 Demonstrate the electrical and electronics engineering concepts by developing working models.

PS02 Model, simulate and develop application specific systems to meet industrial /societal needs.
Detailed Scheme and Syllabus for 2018-22 Batch

### VII Semester

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
<th>L-T-P-S</th>
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<th>CIE</th>
<th>SEE</th>
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<td>Computer Techniques in Power System Analysis</td>
<td>2-2-0-S-J</td>
<td>3</td>
<td>50</td>
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<td>18EE703</td>
<td>Industrial Drives and Applications</td>
<td>3-2-0-0-0</td>
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<td>Relay &amp; High Voltage Engineering Laboratory</td>
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<td>OE-1</td>
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### VIII Semester

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<tr>
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<td>18EE801</td>
<td>Project Phase-II</td>
<td>0-0-24-0-0</td>
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<td>18EE802</td>
<td>Industrial Internship (Minimum one-month duration During</td>
<td>0-0-0-0-0</td>
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<td></td>
<td>Vacations from 2nd to 8th Semester)</td>
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<td>18EEEExxx</td>
<td>Program Elective -6 (G1/2)</td>
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L – Lecture     T- Tutorials     P – Practical     S – Self Study
LIST OF PROGRAM ELECTIVES

List of Program Electives

(Student can register for 7 program electives between 5th to 8th semesters from the list given below. Students are advised to register one elective each from Group-I & Group-II in any semester to avoid SEE of both electives on same day)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Elective Course Title</th>
<th>Course Code</th>
<th>Elective Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>18EEE101</td>
<td>Power Semiconductor Devices</td>
<td>18EEE201</td>
<td>Special Electrical Machines</td>
</tr>
<tr>
<td>18EEE102</td>
<td>Switched Mode Power Converter</td>
<td>18EEE202</td>
<td>Solid State Lighting Control</td>
</tr>
<tr>
<td>18EEE103</td>
<td>Computer Control of Electrical drives</td>
<td>18EEE203</td>
<td>Power Electronics System Design using ICs</td>
</tr>
<tr>
<td>18EEE111</td>
<td>Fuzzy Logic Control</td>
<td>18EEE211</td>
<td>Programmable Logic Controllers</td>
</tr>
<tr>
<td>18EEE112</td>
<td>Artificial Neural Networks</td>
<td>18EEE212</td>
<td>Advanced Instrumentation System</td>
</tr>
<tr>
<td>18EEE113</td>
<td>Advanced Control Theory</td>
<td>18EEE213</td>
<td>Industrial Servo Control Systems</td>
</tr>
<tr>
<td>18EEE114</td>
<td>Robotics and Automation</td>
<td>18EEE214</td>
<td>Discrete Control Systems</td>
</tr>
<tr>
<td>18EEE115</td>
<td>Physiology Control System and Simulation Modelling</td>
<td>18EEE215</td>
<td>Micro- and Nano-Scale Sensors and Transducers</td>
</tr>
<tr>
<td>18EEE121</td>
<td>Renewable Energy Sources</td>
<td>18EEE221</td>
<td>Illumination Technology</td>
</tr>
<tr>
<td>18EEE122</td>
<td>Energy Audit &amp; Demand Side Management</td>
<td>18EEE222</td>
<td>Operation and Maintenance of Solar Electrical Systems</td>
</tr>
<tr>
<td>18EEE123</td>
<td>Electrical Power Quality</td>
<td>18EEE223</td>
<td>Electrical Power Utilization</td>
</tr>
<tr>
<td>18EEE124</td>
<td>Integration of Distributed Generation Systems</td>
<td>18EEE224</td>
<td>Industrial Heating</td>
</tr>
<tr>
<td>18EEE125</td>
<td>Electrical Machines Design</td>
<td>18EEE225</td>
<td>Computer Aided Electrical Drawing</td>
</tr>
<tr>
<td>18EEE131</td>
<td>HVDC Power Transmission</td>
<td>18EEE231</td>
<td>Flexible AC Transmission Systems</td>
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<tr>
<td>18EEE132</td>
<td>Smart Electric Grid</td>
<td>18EEE232</td>
<td>AI Applications to Power Systems</td>
</tr>
<tr>
<td>18EEE133</td>
<td>Modern Power System Protection</td>
<td>18EEE233</td>
<td>Power System Dynamics and Stability</td>
</tr>
<tr>
<td>18EEE134</td>
<td>Power System Planning</td>
<td>18EEE234</td>
<td>Reactive Power Management</td>
</tr>
<tr>
<td>18EEE135</td>
<td>Power System Operation &amp; Control</td>
<td>18EEE235</td>
<td>Electrical Estimation and Costing</td>
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V. **Microelectronics**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>18EEE141</td>
<td>ARM System Architecture</td>
</tr>
<tr>
<td>18EEE142</td>
<td>Analog and Mixed Signal Layout</td>
</tr>
<tr>
<td>18EEE241</td>
<td>Embedded Systems</td>
</tr>
<tr>
<td>18EEE242</td>
<td>Digital Systems Design using HDL</td>
</tr>
<tr>
<td>18EEE243</td>
<td>Introduction to ASIC and FPGA Design</td>
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</table>

VI. **IT and Managements**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>18EEE151</td>
<td>OOPS using C++</td>
</tr>
<tr>
<td>18EEE152</td>
<td>Data structures</td>
</tr>
<tr>
<td>18EEE153</td>
<td>Total Quality Management</td>
</tr>
<tr>
<td>18EEE251</td>
<td>Fundamentals of Python Programming</td>
</tr>
<tr>
<td>18EEE252</td>
<td>Operating System</td>
</tr>
<tr>
<td>18EEE253</td>
<td>Operations Research</td>
</tr>
<tr>
<td>18EEE254</td>
<td>Introduction to Machine Learning with Python</td>
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</tbody>
</table>

VII. **Electric Vehicles Technologies**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>18EEE161</td>
<td>Hybrid Electric Vehicles</td>
</tr>
<tr>
<td>18EEE162</td>
<td>Hybrid and Plug-in Hybrid Vehicles</td>
</tr>
<tr>
<td>18EEE163</td>
<td>Power Electronics &amp; Drives for Electric Vehicles</td>
</tr>
<tr>
<td>18EEE261</td>
<td>Battery storage and Fuel Cells for Electric Vehicles</td>
</tr>
<tr>
<td>18EEE262</td>
<td>Electric Vehicle Battery Charging Methods and Topologies</td>
</tr>
<tr>
<td>18EEE263</td>
<td>Modeling and Control of Hybrid Electric Vehicles</td>
</tr>
</tbody>
</table>

OPEN ELECTIVE Courses to be offered from E&EE Department.

18EE8x10 – Non-Conventional Energy Sources
18EE8x79 – Electric Vehicle Technology.
Core Courses

**COMPUTER TECHNIQUES IN POWER SYSTEM ANALYSIS**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CIE Marks</th>
<th>Total Hours</th>
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<tbody>
<tr>
<td>18EE701</td>
<td>50</td>
<td>26*+26</td>
</tr>
</tbody>
</table>

*Note: Lecture hours indicated are for teaching theoretical concepts. Illustrative examples and numerical problems are to be worked out in tutorial classes.

**Prerequisites:** ENT-I (18EE302), GTD (18EE505), TIM (18EE402), PSAS (18EE601)

**Course Learning Objectives:**
1. To introduce the concepts of network topology and graph theory
2. To Formulate the Y Bus and Z Bus
3. To Formulate and solve load flow problem of a power system network.
4. To justify the need of Economic operation of power system.
5. To introduce the concept of Transient stability and predict system stability

**UNIT – I**


**UNIT – II**

**LOAD FLOW STUDIES:** Introduction, Power flow equations, Classification of buses, Data for load flow, Gauss-Seidal Method – Algorithm and flow chart for PQ and PV buses (numerical problem for one iteration only), Acceleration of convergence; Newton Raphson Method – Algorithm and flow chart for NR method in polar coordinates (numerical problem for one iteration only); Algorithm for Fast Decoupled load flow method; Comparison of Load Flow Methods. 7*+7 Hours

**ECONOMIC OPERATION OF POWER SYSTEM:** Introduction, Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic generation scheduling including generator limits and neglecting losses; Iterative techniques; Economic Dispatch including transmission losses – approximate penalty factor, iterative technique for solution of economic dispatch with losses; Derivation of transmission loss formula; Optimal scheduling for Hydrothermal plants – problem formulation, solution procedure and algorithm. 5*+5 Hours

**UNIT – III**

**TRANSIENT STABILITY STUDIES:** Numerical solution of Swing Equation – Point-by-point method, Modified Euler’s method, Runge-Kutta method, Milne’s predictor corrector method. Representation of power system for transient stability studies – load
representation, network performance equations. Solution techniques with flow charts.

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

1. Apply graph theory concepts to form bus, cut set and loop incidence matrices.
2. Build Ybus and Zbus to model the connected power system network.
3. Apply, compare and analyze various load flow techniques to compute the parameters affecting the power flow at all buses & line flows.
4. Prepare generation scheduling to operate power system economically.
5. Apply various numerical integration techniques to predict system stability.

<table>
<thead>
<tr>
<th>Course Outcomes Mapping with Program Outcomes &amp; PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Outcomes</td>
</tr>
<tr>
<td>18EE701.1</td>
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<td>18EE701.2</td>
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<td>18EE701.3</td>
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<td>18EE701.4</td>
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<tr>
<td>18EE701.5</td>
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</table>

1: Low 2: Medium 3: High

**SEE QUESTION PAPER PATTERN:**
- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit – I & Unit – II and 1 full question from Unit – III.

**TEXTBOOKS:**

**REFERENCE BOOKS:**

**E-Books / MOOC:**
1. NPTEL Course on Computer Aided Power System Analysis, Prof. Biswarup Das, IIT Roorkee

**********************

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Course Learning Objectives:
1. To understand various technological advances happening in the field of electrical and electronics engineering
2. To identify a topic on the advanced electrical and electronics engineering field by extensive literature survey
3. To prepare a document on the selected topic and present in a technical way.

Course Outcomes:
At the end of the course student will be able to
1. Gain knowledge of fast and rapidly changing Electrical and Electronics Engineering by self-learning
2. Identify a topic on the advanced electrical and electronics engineering field after extensive literature survey
3. Write technical documents and give oral presentations on the selected topic using modern tools.
4. Develop the interpersonal skills, presenting skills, soft skills and professional Etiquette.

Course Outcomes Mapping with Program Outcomes & PSO

<table>
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<th>Program Outcomes→</th>
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<th>4</th>
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<th>7</th>
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1: Low 2: Medium 3: High

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Course Learning Objectives:
1. To study the basic principle of industrial drives, its requirements, its characteristics, selection and design and finally different applications.
2. To model an electrical drive and understand its steady state, transient behavior.
3. To understand the need of industrial drives, its control and design of different parameters
4. To select suitable drives for real industrial applications.

UNIT – I

AN INTRODUCTION TO ELECTRICAL DRIVES & ITS DYNAMICS:
Dynamics of electrical drives, Fundamental torque equation, speed torque conventions and multi-quadrant operation. Equivalent values of drive parameters, components of load torque, nature and classification of load torques, calculation of time and energy loss in transient operations, steady state stability, load equalization

8*+5 Hours

UNIT – II

SELECTION OF MOTOR POWER RATING: Thermal model of motor for heating and cooling, Classes of motor duty, determination of motor rating.

DC MOTOR DRIVES: Starting braking, transient analysis

3*+2 Hours

UNIT – III

CONTROL OF DC MOTOR DRIVES:
Single phase fully controlled rectifier, control of dc separately excited motor, Single-phase half-controlled rectifier control of dc separately excited motor.

8*+6 Hours
UNIT – IV

INDUCTION MOTOR DRIVES:
(a) Operation with unbalanced source voltage and single phasing, operation with unbalanced rotor impedances, analysis of induction motor fed from non-sinusoidal voltage supply, starting braking, transient analysis.
(b) Stator voltage control variable voltage frequency control from voltage sources, voltage source inverter control, closed loop control, current source inverter control, current regulated voltage source inverter control, rotor resistance control, slip power recovery, speed control of single phase induction motors.

8*+6 Hours

UNIT – V

SYNCHRONOUS MOTOR DRIVES: Operation form fixed frequency supply, synchronous motor variable speed drives, variable frequency control of multiple synchronous motors. Self-controlled synchronous motor drive employing load commutated thruster inverter.

4*+4 Hours

INDUSTRIAL DRIVES: Rolling mill drives, cement mill drives, paper mill drives, and textile mill drives.

4*+0 Hours

Course Outcomes:
At the end of the course student will be able to
1. Describe the principle and develop mathematical model of electric drives to study their dynamics.
2. Analyze electrical and thermal dynamics of drives & select the power rating.
3. Apply suitable power electronics converter to control DC motor drive.
4. Develop steady-state and transient model of induction motor & identify desired power electronics converter to control the motor.
5. Describe synchronous motor drive control scheme and applications of various industrial drives.

Course Outcomes Mapping with Program Outcomes & PSO

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1: Low 2: Medium 3: High
* - If simulation task is conducted in CIE, else no mapping

SEE QUESTION PAPER PATTERN:
- There will be 10 questions of 20 marks each in the question paper categorized into 5 units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting one full question from each unit.
TEXTBOOK:

REFERENCE BOOKS:

E-Books / MOOC
1. NPTEL Course on Industrial Drives by Prof. K. Gopakumar, IISc Bangalore
2. Electrical machines and drives by Dr. Ir. Henk Polinder on MIT OpenCourseWare

*************

RELAY AND HIGH VOLTAGE LABORATORY

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Course Learning Objectives:
1. To find breakdown voltage & dielectric strength of given transformer oil.
2. To demonstrate the operation of various relays like electromechanical and static relays.
3. To get the operating parameters of relays
4. To measure HVDC and HVAC by sphere gap
5. To measure HVAC by rod gap techniques.

List of Experiments
Total 10 experiments are to be conducted

PART – A (Choose at least two experiments)
1. Over current relay:
   a. IDMT non-directional characteristics
   b. Directional features
   c. IDMT directional
2. IDMT characteristics of over voltage or under voltage relay. (solid state or electromechanical type)
3. a. To determine 50% probability flashover voltage for air insulation subjected to impulse voltage.
   b. Generation of standard lightning impulse voltage and to determine efficiency and energy of impulse generator. Operating characteristics of over voltage or under voltage relay. (Solid state or electromechanical type).
4. Operation of negative sequence relay.
5. Bias characteristics of differential relay.
6. Current-time characteristics of fuse.

PART – B (Choose at least one experiment)
1. Operating characteristics of microprocessor based (numeric) over-current relay.
2. Operating characteristics of microprocessor based (numeric) distance relay.
3. Operating characteristics of microprocessor based (numeric) over/under voltage relay.

PART – C (Choose at least one experiment)
1. Generator protection –Merz-Price- protection scheme.
2. Feeder protection scheme-fault studies.

PART – D (Choose at least two experiments)
1. Spark over characteristics of air insulation subjected to high voltage AC with spark over voltage corrected to STP.
2. Spark over characteristics of air insulation subjected to high voltage AC, with spark over voltage corrected to STP for uniform and non-uniform field configuration.
3. Spark over characteristics of air insulation subjected to high voltage dc
5. Breakdown strength of transformer oil using oil-testing UNIT.
6. Field mapping using electrolytic tank for any one-model cable/capacitor/transmission line/ Sphere gap models.

Course Outcomes:
At the end of the course student will be able to
1. Test the given transformer oil and measure its breakdown voltage & dielectric strength.
2. Apply the principle of operation of electromechanical and static relays to obtain its desired characteristics.
3. Analyze the concept field mapping using electrolytic tank for the measurement of capacitance for different electrodes.
4. Apply concept of HV technology for the measurement of HVDC and HVAC by sphere gap and rod gap techniques.

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************
# POWER SYSTEM SIMULATION LABORATORY

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## Course Learning Objectives:
1. To introduce the power angle diagram and swing curve of an alternator
2. To formulate the Y Bus and determine various bus parameters and line flows
3. To determine the parameters in a single transmission system with Y-∆ transformers at a specified location for various faults.
4. To perform Load flow analysis using various techniques.
5. To perform optimal generator scheduling for thermal power plants.

## List of Experiments

**Power system simulation using MATLAB /Simulink and MiPower Software Packages**

1. Determination of Power angle diagrams for Salient and Non- Salient pole Synchronous machines, reluctance power, excitation e.m.f. and regulation.
2. Y Bus formation for power system with & without mutual coupling by Singular transformation.
3. Y Bus formation for power system by Inspection method.
5. ABCD Parameters:
   a. For symmetric Π/T configuration.
   b. Verification of AD–BC = 1.
   c. Determination of Efficiency and Regulation.
6. Determination of bus current, bus power & line flows for a specified system voltage (bus) profile.
7. To determine fault current and voltage in a single transmission system with Y-∆ transformers at a specified location for SLGF, DLGF and LLF
8. Load flow analysis using Gauss–Seidel method for both P –Q and P-V buses
10. Optimal Generator scheduling for thermal power plants.
11. Plot swing curve for a single machine connected to infinite bus through a pair of identical transmission lines, for a 3–phase fault on one of the lines for variation of inertia constant/line parameters/fault location/clearing time/pre fault electrical output.

## Course Outcomes:
At the end of the course student will be able to
1. Develop the power angle diagram and swing curve of an alternator
2. Formulate the Y Bus by various methods and determination of bus currents, bus power and line flows for a specified system
3. Determine the fault current and voltage in a single transmission system with Y-∆
transformers at a specified location for symmetric unsymmetrical faults
4. Perform Load flow analysis using linear and quadratic convergence methods.
5. Perform optimal generation scheduling for thermal power plants.

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Course Learning Objectives:
1. To prepare a project proposal based on theoretical understanding of the concepts and literature survey.
2. To conduct a feasibility study of the proposed project work.
3. To arrive at design specifications.

Course Outcomes:
At the end of the course student will be able to
1. Apply theoretical concepts to identify an engineering problem.
2. Review literature to understand the state-of-the-art technologies.
3. Build a team and contribute effectively towards the project.
4. Develop technical writing and presentation skills to communicate effectively.
5. Formulate a project proposal with frozen design specifications to prepare project execution plan.

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**Project Phase - II**

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**CIE Marks**:  
- Project Evaluation: 50%  
- Report (Guide): 50%

**SEE Marks**:  
- Report (Examiners): 50%  
- Presentation: 40%  
- Project Exhibition: 10%

**Course Learning Objectives:**
1. To expose students to the 'real' working environment and get acquainted with the organization structure, business operations and administrative functions.
2. To set the stage for future recruitment by potential employers.
3. The capacity to observe astutely and propose and defend opinions and ideas with tact and conviction is the invaluable learning outcome for the Collegiate Seminar student. Not a mere recipient of ideas, the student is a participant in discovery and inquiry.

**Course Outcomes:**
At the end of the course student will be able to
1. Design, build, and test electrical and electronics-based project.
2. Apply project management skills (scheduling work, procuring parts, and documenting expenditures and working within the confines of a deadline).
3. Develop and demonstrate troubleshooting ability.
4. Demonstrate and communicate technical information by means of written reports and oral presentations.

**Course Outcomes Mapping with Program Outcomes & PSO**

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1: Low 2: Medium 3: High
Course Learning Objectives:
Internship provides students with the opportunity of hands-on experience that includes personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies, etc.

The objective is further:
1. To put theory into practice.
2. To expand thinking and broaden the knowledge and skills acquired through course work in the field.
3. To relate to, interact with, and learn from current professionals in the field.
4. To gain a greater understanding of the duties and responsibilities of a professional.
5. To understand and adhere to professional standards in the field.
6. To gain insight into professional communication including meetings, memos, reading, writing, and public speaking.

Internship:
- All the students admitted to BE shall have to undergo mandatory internship of 4 weeks during the vacation at the end of 4th, 5th, 6th and/or 7th semester.
- A University examination shall be conducted during VIII semester. Internship shall be considered as mandatory non-credited course for the award of degree.
- Those who do not take up/complete the internship shall be declared a letter grade NP and shall have to complete during subsequent University examination after satisfying the internship requirements.
- Students under the guidance of internal and external guides shall take part in all the activities regularly to acquire the knowledge of best practices in industry.

Guidelines for Internship:
1. The internship can be carried out in any Industry/ R&D Organization/ Research Institute.
2. The duration of internship is one month which can be carried out in stages if required.
3. Internship will be allowed from II semester onwards during summer vacation.
4. After the completion of internship, copy of the certificate along with Internship Report should be submitted to respective Head of Department.
5. Total marks for the internship will be 100 (CIE 50 Marks + SEE 50 Marks)
6. Evaluation (both CIE & SEE) will be conducted at the end 8th semester.
Seminar: Each student is required to
- Present the seminar on the internship using power point slides.
- Answer the queries and involve in debate/discussion to get motivated to reach high standards and become self-confident.
- Submit the report duly certified by the guide from industry.

Course Outcomes:
At the end of the course the student will be able to:
1. Gain practical experience within industry in which the internship is done.
2. Acquire knowledge of the industry in which the internship is done.
3. Develop a greater understanding about career options to clearly define personal career goals.
4. Experience the activities and functions of professionals.
5. Develop and refine oral and written communication skills

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<th>Course Outcomes Mapping with Program Outcomes &amp; PSO</th>
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Open Electives Offered by E & E Department

**NON-CONVENTIONAL ENERGY SYSTEMS**

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Prerequisite:
Students are expected to have a fundamental knowledge of Basic Electrical Engineering (18EE105)

Course Learning Objectives (CLO):
1. To illustrate the principle of extraction of energy from conventional, nonconventional sources.
2. To demonstrate the working principle and applications of solar based thermal, electrical and PV systems.
3. To justify the usage of energy storage techniques and understand the process of design and implement wind based energy conversion systems.
4. To understand the process of design and implement biomass based energy conversion systems.
UNIT – I


3 Hours


5 Hours


4 Hours


4 Hours

UNIT – II


4 Hours


4 Hours


6 Hours
UNIT – III


Course Outcomes:
At the end of the course student will be able to
1. Describe non-conventional energy sources and solar radiation geometry to estimate and measure solar radiation.
2. Apply the principle of solar radiation into heat to understand the operation of solar thermal and solar electric systems.
3. Describe energy storage methods and wind–energy conversion systems to understand the factors influencing power generation.
4. Review the biomass conversion technologies to design biomass-based energy systems.
5. Describe tidal, ocean thermal and fuel cell energy conversion systems to understand emerging non-conventional energy technologies.

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1: Low 2: Medium 3: High

SEE Question Paper Pattern:
- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit – I&Unit – II and 1 full question from Unit – III.
TEXTBOOK:

REFERENCE BOOKS:

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<tr>
<td>Teaching Hours/Week (L:T:P)</td>
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Prerequisites: Applicable for all Engineering Stream except E&E

Course Learning Objectives:
1. To Understand the fundamental laws and vehicle mechanics.
2. To Understand working of Electric Vehicles and recent trends.
3. Ability to analyze different power converter topology used for electric vehicle application.
4. Ability to develop the electric propulsion unit and its control for application of electric vehicles.

UNIT – I


UNIT – II

Energy storage for EV and HEV: Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Supercapacitors.

Electric Propulsion:
EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.

UNIT – III

**Design of Electric and Hybrid Electric Vehicles:** Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design.

9 Hours

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

1. Explain the roadway fundamentals, laws of motion, vehicle mechanics and propulsion system design.
2. Explain the working of electric vehicles and hybrid electric vehicles in recent trends.
4. Analyze DC and AC drive topologies used for electric vehicle application.
5. Develop the electric propulsion unit and its control for application of electric vehicles.

SEE QUESTION PAPER PATTERN:
- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit – I & Unit – II and 1 full question from Unit – III.

**TEXTBOOKS:**
REFERENCE BOOKS:

E-Books / MOOC:
1. Introduction to Mechanics | Coursera
2. NPTEL :: Electrical Engineering - Introduction to Hybrid and Electric Vehicles
3. Electric Vehicles – Part 1 - Course (nptel.ac.in)
4. Hybrid Vehicles (edX) | MOOC List (mooc-list.com)
5. NPTEL: Electrical Engineering - Introduction to Hybrid and Electric Vehicles

***************
B. E. SYLLABUS

2021-22

ELECTRICAL & ELECTRONICS ENGINEERING
2018-22 Batch

VII & VIII SEMESTER

With Scheme
of
Teaching & Examination
(Program Elective Courses)
I. POWER ELECTRONICS & DRIVES

### POWER SEMICONDUCTOR DEVICES

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**Prerequisites:** Knowledge of Basic Semiconductor devices.

**Course Learning Objectives:**

1. To understand the principle of operation of power MOSFET and IGBT with their characteristics and effect of reverse recovery transients on switching stresses & losses
2. To study the construction and switching characteristics of various power semiconductor devices
3. To illustrate the importance of gate drive circuits for power devices, design of snubber circuits and heat sinks.

**UNIT – I**

**Introduction:** Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); selection strategy – On-state and switching losses – EMI due to switching – Power diodes – Types, forward and reverse characteristics, switching characteristics – rating  

**Power MOSFET:** Basic structure & operation, I-V Characteristics, On-state operation, Turn-on, turn-off process, switching characteristics: Turn-on transient, dv/dt capability, Turn-off transient, turn-off time, Switching losses, Safe operating Area, Effect of reverse recovery transients on switching stresses & losses, dv/dt limitations.  

6 Hours

**UNIT – II**

**Power IGBT:** basic structure & operation, i-v characteristics, Latch-up in IGBT, Switching characteristics: turn-on, Turn-off transient, current tailing, Switching losses, Device limits & SOA, Over-current & short-circuit protection of IGBT  

8 Hours

**Power Electronics Devices:** Construction and features of – Phase Controlled thyristors, inverter graded thyristors, ASCR, RCT, SUS, SBS, SCS, GTO, MCT, SIT, IGCT, MTO, ETO, PIC. Comparison of power devices.  

8 Hours

**UNIT – III**

**Firing and Protecting Circuits:** Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. – Over voltage, over current and gate protections; Design of snubbers, Guidance for heat sink selection, heat sink types and design – Mounting types.  

9 Hours
Course Outcomes:
At the end of the course student will be able to
1. Analyze characteristics of power semiconductor devices to select an appropriate device for given application
2. Summarize switching and I-V characteristics of MOSFET to know the maximum switching frequency limit.
3. Analyze the I-V and switching characteristics to summarize dv/dt and di/dt limitations, over current and short circuit protections to ensure safe operation of IGBT.
4. Describe the construction and features of the emerging power electronic devices.
5. Analyze the importance of gate drive and protection circuits to switch power electronic converters.

Course Outcomes Mapping with Program Outcomes & PSO

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SEE Question Paper Pattern:
- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit – I&Unit – II and 1 full question from Unit – III.

TEXTBOOKS:

REFERENCE BOOKS:

E-Books / MOOC
1. Module 1 of http://www.nptel.ac.in/courses/Webcourse-contents/IIT20Kharagpur/Power%20Electronics/New_index1.html
2. https://www.coursera.org/learn/converter-zircuits/lecture/b5VYY/sect-4-2-0-introduction-to-power-semiconductors

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SWITCHED MODE POWER CONVERTERS

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Prerequisites: Power Electronics (18EE504).

Course Learning Objectives:
1. To introduce the concept of switched mode power converters
2. To study the working of non-isolated and isolated DC-DC switching power converters
3. To understand the working of switched mode DC-AC inverters
4. To understand the concept of resonant converter
5. To study various power line disturbance and power conditioners
6. To design high frequency transformer and inductor

UNIT – I

DC-DC switched mode converter topologies: Introduction, generalized comparison between switched mode and linear dc regulator, Control of dc-dc converters, Buck, Boost, Buck-Boost, Cuk dc-dc converter topologies, Full-bridge dc-dc converter.  
9 Hours

DC-DC converter with isolation: Flyback converters, other Flyback converter topologies, forward converter, push-pull converter, half and full bridge converter.  
7 Hours

UNIT – II

DC-AC switched mode inverters: Basic concept of switch-mode Inverters, single-phase inverter, three phase inverters. SPWM inverter, detailed theory, working principles, modes of operation with circuit analysis, ripple in the inverter output, switch utilization, problems.  
8 Hours

Resonant switch converters: Classification of resonant converter, Resonant switch converter – ZCS, ZVS, ZVS-CV dc-dc converters; Resonant dc-link inverter with ZVS, problems.  
7 Hours

UNIT – III

Power line disturbances, Power Conditioner, Uninterruptible Power Supplies, solar power based bidirectional inverter.
High frequency inductor and transformers design: specific inductor, transformer design, Inductor and transformer design procedure.  
8 Hours
Course Outcomes:
At the end of the course student will be able to
1. Compare and contrast the Linear Voltage Regulator & SMPC. Describe the working principle of various non-isolated dc-dc converters and design the converter for a given specification
2. Describe the principle of operation of various isolated dc-dc converter and illustrate the design steps to be followed.
3. Analyze various switched mode inverters configurations to calculate performance parameters.
4. Analyze the performance of different resonant converters base on their working principle.
5. Design the magnetic components to be used in switched mode power supply and analyze the role of power conditioners to suppress various power line disturbances.

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TEXTBOOKS:

REFERENCE BOOKS:

E Books /MOOC/ NPTEL
1. http://nptel.ac.in/courses/108108036/

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COMPUTER CONTROL OF ELECTRICAL DRIVES

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Prerequisites: Power Electronics (18EE504), Industrial Drives and Applications (18EE703).

Course Learning Objectives:
1. Review the applications micro controllers and power electronics in industrial drives
2. Explain the classification and control of AC drive using digital logic
3. Illustrate the control of synchronous machine and phase controlled converters.
4. Explain the principals of slip power recovery schemes and effect of EMI.
5. Identify the use of expert system application to drives and understand the concept of vector control of ac drives.

UNIT – I

REVIEW OF MICRO CONTROLLERS IN INDUSTRIAL DRIVES
SYSTEM: Typical Micro controller’s 8 bit 16 bit (only block diagram) Digital Data Acquisition system, voltage sensors, current sensors, frequency sensors and speed sensors.

EVOLUTION OF POWER ELECTRONICS IN DRIVES: Power semiconductors devices used for drives control, Ratings, comparison and their applications. Block diagram of power integrated circuit for DC motor drives.

AC MACHINE DRIVES: general classification and National Electrical Manufacturer Association (NEMA) classification, Speed control of Induction motors with variable voltage constant frequency, constant voltage variable frequency, (v/f) constant operation, drive operating regions. Variable stator current operation. Effect of Harmonics.

UNIT – II

SYNCHRONOUS MACHINE DRIVES: Wound field machine, comparison of Induction and wound field synchronous machines, Torque angle characteristics of salient pole synchronous machines, synchronous reluctance permanent magnet synchronous machines (SPM), variable reluctance machines (VRM).

PHASE CONTROLLED CONVERTERS: Converter controls, Linear firing angle control, cosine wave crossing control, phase locked Oscillator principle
Electromagnetic Interference (EMI) and line power quality problems, cyclo converters, voltage fed converters, Rectifiers, Current fed Converters.

PRINCIPALS OF SLIP POWER RECOVERY SCHEMES: Static Kramer’s drive system, block schematic diagram, phasor diagram and limitations, Static Scherbins scheme system
using D.C link converters with cyclo converter modes of operation, modified Scherbins Drive for variable source, constant frequency (VSCF) generation

5 Hours

UNIT – III

PRINCIPLE OF VECTOR CONTROL OF A C DRIVES: Phasor diagram, digital Implementation block diagram, Flux vector estimation, indirect vector control block diagram with open loop flux control, synchronous motor control with compensation.

4 Hours

EXPERT SYSTEM APPLICATION TO DRIVES (ONLY BLOCK DIAGRAM): Expert system shell, Design methodology, ES based P-I tuning of vector-controlled drives system, Fuzzy logic control for speed controller inverter control drives, structure of fuzzy control in feedback system.

4 Hours

Course Outcomes:

At the end of the course student will be able to

1. Describe the advances in microcontrollers and power electronics to understand their application in industrial drives.
2. Analyze different speed control methods of AC drives to choose appropriate method for a given drive requirements.
3. Analyze torque angle characteristics of synchronous motor drive, synchronous reluctance and variable reluctance machines, Understand phase-controlled converters used in control of electrical dives
4. Describe the principals of slip power recovery schemes to improve the efficiency of drive.
5. Describe principle of vector control of AC drives and application of expert systems for control of electrical drives.

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TEXTBOOKS:

REFERENCE BOOKS:
1. “Advanced Microprocessor and Interfacing”- Badri Ram TMH, 2001

SPECIAL ELECTRICAL MACHINES

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Prerequisites: DCSM (18EE303), TIM (18EE402).

Course Learning Objectives:
1. To study the working principle of stepper motor and its control
2. To understand working of switched reluctance motor
3. To know the difference between PMDC & BLDC motors
4. To understand principle of operation of permanent magnet synchronous motor
5. To introduce single phase special machines

UNIT – I

Stepper Motor: Variable reluctance (VR) Stepper Motor, Permanent Magnet Stepper Motor, Hybrid Stepper Motor, Other Types, Windings of Stepper Motor, open -loop, closed loop control of stepper motor, Microprocessor based control of stepper motor.

Switched Reluctance Motor (SRM): Construction, Principle of working, Basic SRM analysis, constraints on pole arc and tooth arc, Power Converter Circuits, Control of SRM, Rotor Position sensors, Current Regulator, Microprocessor Based Control of SRM, Sensorless Control of SRM.

UNIT – II

Synchronous Reluctance Motor (SyRM): Construction, Working, Control of SyRM, Advantage, Applications.

PMDC and BLDC Motors: Permanent Magnet DC (PMDC) Motor – Construction, working, Types of PMDC Motors, Brushless Permanent Magnet DC (BLDC) Motors – Classification, construction, Electronic commutation, principle of operation, BLDC square wave motor, Types of BLDC motor, Control of BLDC motor, Microprocessor Based control, DSP Based Control, Sensorless Control, Comparison of DC and BLDC motor, Applications.

Permanent Magnet Synchronous Motor: Construction, principle of operation, Control of PMSM, Applications of PMSM.
UNIT – III


5 Hours

**Servo Motors:** DC Servo Motors – Construction, Principle of operation, voltage equation, control of DC servo motor. AC Servo Motor – Construction, working, torque speed characteristics.  

4 Hours

**Course Outcomes:**
At the end of the course student will be able to
1. Describe working principle of different stepper motor types to achieve microprocessor based control.
2. Summarize working principle and requirements of power converter to achieve sensorless control of switched reluctance motor.
3. Compare and differentiate PMDC & BLDC motors to select a drive based on requirements
4. Describe the principle of operation of permanent magnet synchronous motor.
5. Understand the operation of single phase special machines.

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**TEXTBOOK:**
1. E. G Janardanan, ‘Special Electrical Machines’ PHI Delhi, 2014.

**REFERENCE BOOKS:**

**************
SOLID STATE LIGHTING CONTROL

Course Code: 18EEE202  CIE Marks: 50
Teaching Hours/Week (L:T:P): 3:0:0  SEE Marks: 50
Total Hours: 39  Credits: 03

Course Learning Objectives:
1. To acquaint knowledge different types of light source and its utility.
2. To know the integration of lighting in diverse application.
3. To upgrade the knowledge in smart lighting.
4. To enumerate the skill in energy saving using solid state lighting.
5. To give insight to design steps involved in building solid state lighting

UNIT – I

Introduction: different types of light source – black body radiator, human vision, mesopic, scotopic, photopic vision, human light transduction model, lumen, luminous intensity, illumination, luminous efficacy, maintenance factor, depreciation factor, photometric analysis. 7 Hours

Color science: introduction to solid state lighting, construction of solid state lighting source, color rendition, correlated color temperature, binning, Macadam ellipse, different steps in Macadam ellipse, chromaticity diagram, color mixing, color evaluation techniques objective and subjective color analysis – problems 8 Hours

UNIT – II

Converters for Lighting: drivers, linear regulator, switch mode regulators using buck, boost and buck boost converter 8 Hours

Light and health: light as radiation, tissue damage by ultraviolet radiation, Tissue Damage by Visible and Near Infrared Radiation, Tissue Damage from Infrared Radiation beyond 1400 nm, Threshold Limit Values, Practical Considerations, Aging Effects, Risk of Exceeding Limits, Using Task Lights, Eyestrain, Migraine, Autism, Visual Comfort and Human Variability, Light Operating through the Circadian System, Sleep, blue light hazard. 9 Hours

UNIT – III

Application of Solid-state lighting: Horticulture lighting, Hospital lighting, architectural lighting, commercial lighting, Seasonal Affective disorder, Alzheimer, museum lighting. 7 Hours
Course Outcomes:
At the end of the course student will be able to
1. Analyze the color discrimination of the light source based on subjective and objective analysis
2. Identify the LED binning and illustrate the importance of Macadam ellipse
3. Categorize the color characteristic of the light source
4. Design the drivers for LEDs based on linear and switch mode regulators
5. Comprehend the application of solid-state lighting in health, commercial and non-commercial sectors

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TEXTBOOKS:

REFERENCE BOOKS:
1. LED lighting a primer to lighting the future Sal Cangeloso, Maker press, 2012

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POWER ELECTRONICS SYSTEM DESIGN USING ICs

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Course Learning Objectives:
1. Analyze power electronic systems using ICs and apply the knowledge in a theoretical context.
2. Understand switching regulator control circuits
3. Design high performance power electronic circuits using different ICs for various applications.
4. Think laterally and originally to solve power electronic circuits, and evaluate problems for switching power supplies.
5. Analyze Power Plant control using Programmable Logic Controller.

UNIT – I

Introduction: Measurement techniques for voltages, current, power, power factor in power electronic circuits, other recording and analysis of waveforms, sensing of speed.  
7 Hours

Switching Regulator Control Circuits: Introduction, isolation techniques of switching regulator systems, PWM systems.  
8 Hours

UNIT – II

Commercial PWM Control ICs and their Applications: TL 494 PWM Control IC, UC 1840 Programmable off line PWM controller, UC 1524 PWM control IC, UC 1846 current mode control IC, UC 1852 resonant mode power supply controller.  
8 Hours

8 Hours

UNIT – III

Programmable Logic Controllers (PLC): Basic configuration of a PLC, Programming and PLC, program modification, power plant control using PLCs.  
8 Hours

Course Outcomes:
At the end of the course student will be able to
1. Describe the techniques used for measurements of parameter in a power electronics circuit.
2. Describe the operation of switching regulator control circuits
3. Understand the architecture of commercial PWM control ICs.
4. Describe switching power supply ancillary, supervisory & peripheral circuits and components used in designing switching power supply.
5. Apply Programmable Logic Controller in power plant control.
### Course Outcomes Mapping with Program Outcomes & PSO

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### TEXTBOOKS:
3. UNIT rode application notes: http://www.smps.us/UNIT rode.html

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II. CONTROL SYSTEM

FUZZY LOGIC CONTROL

<table>
<thead>
<tr>
<th>Course Code</th>
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<td>39</td>
<td>Credits</td>
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</table>

**Course Learning Objectives:**

1. To differentiate conventional Set theory and Fuzzy logic
2. To study the concept of linguistic variables and inference rules
3. To analyse the application of fuzzy logic controller systems.
4. To understand the fuzzy knowledge-based controllers (FKBC)
5. To understand the process of performance monitoring and adaption mechanism using FKBC.

**UNIT - I**

Introduction: Fuzzy sets, Properties of fuzzy sets, operation in fuzzy sets, fuzzy relations, cardinality operations on fuzzy relations, Fuzzy Cartesian product and composition, fuzzy Tolerance and equivalence relations.

7 Hours

Theory of approximate reasoning: Linguistic variables, linguistic hedges, Fuzzy if then statements, inference rules, compositional rule of inference, graphical technique of inference, Fuzzification and defuzzification procedures.

8 Hours

**UNIT - II**


10 Hours

Fuzzy knowledge-based controllers (FKBC): Basic concept structure of FKBC, choice of membership functions, scaling factors, rules, FKBC as a Non-linear transient element, Design of P, PI, PD, PID controllers, sliding mode FKBC, Sugeno FKBC.

8 Hours

**UNIT - III**

ADAPTIVE FUZZY CONTROL: Process performance monitoring, adaption mechanisms, membership functions, tuning using gradient descent and performance criteria. Set organizing controller, Model based controller.

6 Hours
Course Outcomes:
At the end of the course student will be able to
1. Describe the fundamentals of Fuzzy logic to apply in systems with uncertainty.
2. Classify the linguistic variables & inference rules to formulate knowledge based system
3. Design sample fuzzy control systems to study the system behavior
4. Analyze fuzzy knowledge-based controllers (FKBC) to compare its performance with conventional controllers.
5. Describe the adaptive fuzzy control system to enhance the performance of FKBC systems.

Course Outcomes Mapping with Program Outcomes & PSO

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<th>Program Outcomes</th>
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</table>
1: Low 2: Medium 3: High

SEE Question Paper Pattern:
- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit – I&Unit – II and 1 full question from Unit – III.

TEXTBOOKS:

REFERENCE BOOKS:

E-Books / MOOC/ NPTEL
1. http://nptel.ac.in/courses/108104049/
2. http://videolecures.net/acai05_bethold_fl/

***************
ARTIFICIAL NEURAL NETWORKS

<table>
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<td>Total Hours</td>
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<td>Credits</td>
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**Course Learning Objectives:**
1. To introduce the concept and use of ANN
2. To explain the concept of supervised learning and various learning algorithms.
3. To illustrate the use of Accelerating learning process and need of prediction network
4. To familiarize with the concept of Learning vector quantizing and associative modeling
5. To understand the need of optimization and different optimization algorithms

**UNIT – I**

Introduction, history, structure and function of single neuron, neural net architectures, neural learning, use of neural networks. 7 Hours
Supervised learning, single layer networks, perceptron's, linear separability, perceptron training algorithm, guarantees of success, modifications. 4 Hours
Multiclass networks-I, multilevel discrimination, preliminaries, back propagation, setting parameter values, theoretical results. 5 Hours

**UNIT – II**

Accelerated learning process in layered neural network, application, mandaline, adaptive multilayer networks. 4 Hours
Prediction networks, radial basis functions, polynomial networks, regularization, unsupervised learning, winner take all networks. 4 Hours
Learning vector quantizing, counter propagation networks, adaptive resonance theorem, topologically organized networks, distance-based learning, noncognition. 4 Hours
Associative models hop field networks, brain state networks, Boltzmann machines, hetero associations. 4 Hours

**UNIT – III**

Optimization using hop filed networks, simulated annealing, random search, evolutionary computation. 7 Hours
Course Outcomes:
At the end of the course student will be able to
1. Describe the architecture of neural network to identify the functionalities of different layers.
2. Apply the single layer and multilayer learning algorithms to solve nonlinear system.
3. Describe the accelerated learning process and unsupervised learning algorithm.
4. Analyse the learning vector quantizing and associative modelling techniques to solve uncertainty in the system.
5. Describe the various neural network optimization algorithms

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<th>Course Outcomes Mapping with Program Outcomes &amp; PSO</th>
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1: Low 2: Medium 3: High

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TEXTBOOKS:

REFERENCE BOOKS:

E-Books / MOOC
1. http://nptel.ac.in/courses/117105084/
3. http://cse22-iiith.vlabs.ac.in/

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ADVANCED CONTROL THEORY

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Prerequisites: Linear Control System (18EE503), VCTT (18EE301)

Course Learning Objectives:
1. To outline the state model and deduce the state equations for LTI systems.
2. To compute state transition matrix, the Eigen values and Eigen vectors.
3. To analyze the system for controllability and observability.
4. To design the controller using pole placement techniques to ensure stability.
5. To understand the behaviour of non-linear system and analyse the phase trajectory
6. To study the Lyapunov stability criteria for nonlinear systems.

UNIT - I

State variable analysis & design, canonical representation and transfer function, linearization of state equations, State space representation using physical variables. State space representation using phase variables & canonical variables, Derivation of transfer function from state model, Solution of state equation.

7 Hours

State transition matrix & its properties, computation using Laplace transformation, Cayley-Hamilton method (only computation), Eigenvalues, Eigen vectors, generalized Eigen vectors, diagonalization.

7 Hours

UNIT - II

Concept of controllability & observability, methods of determining the same. Pole placement techniques: stability improvements by state feedback, necessary & sufficient conditions for arbitrary pole placement.

8 Hours

Introduction, behaviour of non-linear system, common physical non-linearity-saturation, friction, backlash, dead zone, relay, multi variable non-linearity, Phase plane method, singular points, stability of nonlinear system, limit cycles, construction of phase trajectories by Isocline method and Delta method.

9 Hours

UNIT - III

Lyapunov’s stability criteria for linear as well as nonlinear systems, stability definitions, theorems, sign definiteness, direct method, second method, Krasovskii’s method, variable gradient method and for linear systems for state variable models.

8 Hours
**Course Outcomes:**
At the end of the course student will be able to
1. Develop various state space model to obtain the transfer function for LTI system
2. Compute state transition matrix to solve the state equation
3. Analyze the pole placement techniques to enhance the stability of the system.
4. Analyze the behavior of nonlinear system & evaluate various methods of stability to understand the system behavior.
5. Apply Lyapunov criteria to evaluate the Stability of linear and nonlinear system.

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<tr>
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1: Low  2: Medium  3: High

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**TEXTBOOKS:**

**REFERENCE BOOKS:**

**E Books /MOOC/ NPTEL**
1. http://nptel.ac.in/courses/108103007/
2. https://www.coursera.org/learn/designing-organization/lecture/Md2km/4-2-2-traditional-control-systems
3. https://www.edx.org/course/introduction-control-system-design-first-mitx-6-302-0x

***************
Course Learning Objectives:
1. To understand the basic of composition of a robot
2. To illustrate various robot sensors and construction of robot
3. To familiarize the concept of kinematics of the robot
4. To enumerate the functions and advantages of the robot
5. To know the robot programming concept

UNIT – I

8 Hours

Robot sensors: Introduction, desirable features of sensors, magnetic sensors, fibre optic, tactile sensors, proximity and non-proximity sensors.  
4 Hours

Manipulators, Actuators and grippers: Construction of manipulators, types of actuators, grippers, classification, force analysis of gripper mechanism, designing of grippers.  
4 Hours

UNIT – II

Control: Introduction, Actuator dynamics, Set-Point Tracking, Drive Train Dynamics, Trajectory Interpolation, Feed forward Control and Computed Torque.  
4 Hours

Kinematics: Forward, inverse and velocity kinematics Denavit-Hardenberg Representation, Examples  
4 Hours

Dynamics: Euler Lagrange Equations, Expressions for kinetic and potential energy, Equation of Motions, Common configuration, Newton Euler Formulation.  
Robot machine vision: Introduction, image processing and analysis.  
7 Hours

UNIT – III

Robot programming: Lead through programming methods, Robot programming languages–examples.  
5 Hours

Case studies: Robot applications in manufacturing, robot cell design, machine interface, multiple robots, robot in assembly and inspection.  
4 Hours
Course Outcomes:
At the end of the course student will be able to
1. Recognize the components and classify robots based on its composition
2. Identify and describe various sensors to construct the robot.
3. Derive the kinematics of the robot to derive the control aspects
4. Apply the mathematical models to validate the dynamics of the system
5. Identify different programming methods and languages to the effective functioning of robot.

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1: Low 2: Medium 3: High

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REFERENCE BOOKS:
5. Saeed B. Niku, Introduction to robotics, PHI, 2005

E-Books / MOOC /NPTEL
1. NPTEL Course on “Robotics and Control: Theory and Practice” by Prof. N. Sukavanam, Prof .M. Felix Orlando, Department of Mathematics IIT Roorkee
2. http://nptel.ac.in/downloads/112101099/
PHYSIOLOGY CONTROL SYSTEM AND SIMULATION MODELLING

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<td>Credits</td>
<td>03</td>
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</table>

Prerequisites: Control Systems, VCTT, PTNM

Course Learning Objectives:
1. To introduce the basic system concepts and differences between an engineering and physiological control systems.
2. To acquaint students with different mathematical techniques applied in analysing a system and the various types of nonlinear modelling approaches.
3. To teach neuronal membrane dynamics and to understand the procedures for testing, validation, and interpretation of physiological models.
4. To study the cardiovascular model and apply the modelling methods to multi-input and multi output systems.

UNIT – I

Introduction to Physiological control systems: -Introduction, Similarities and difference with Technological control, Transfer of substances between physiological compartments: By diffusion, by fluid flow and separated by a thin membrane using differential equations.  
Regulation in physiological control system: Regulation of electrolyte concentration, acid base balance, red blood cell production, arterial pressure, blood volume, respiration, body temperature, blood glucose.

UNIT – II

Biological control structure and modelling: Basic control structure and detailed parameters, Biofeedback, modelling of human thermal regulatory system including control aspects, Biochemistry of digestion, types of heat loss from body.  
Control and regulation of respiratory system: Modelling of oxygen uptake, mass balance of lungs, gas transport mechanism of lungs, oxygen and carbondioxide transport in blood and tissue.

UNIT – III

Application of biological control: Eye tracking control, Pupil control.
MATLAB Application and simulation: Derivation of Cardiovascular control system theoretical and using matlab.
Course Outcomes:
At the end of the course student will be able to
1. Comprehend the basic system concepts and differences between an engineering and physiological control systems.
2. Understand the application of various mathematical techniques in designing a bio-control system.
3. Comprehend the techniques of plotting the responses in both the domain analysis.
4. Apply time domain and frequency domain analysis to study the biological systems.
5. Develop simple models of the physiological control systems and analyze its stability.

SEE Question Paper Pattern:
- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit – I & Unit – II and 1 full question from Unit – III.

TEXTBOOKS:
1. Bio- Medical Engineering Principles By: David. Cooney, Michel Deckker INC.
3. The Application of Control Theory of a Physiological System by Howard T Milhorn
4. Automatic control systems: By Benjamin C Kuo.

REFERENCE BOOKS:

List of experiments for task by simulation

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<tbody>
<tr>
<td>1</td>
<td>Develop a mathematical model and analyse the response of muscle stretch reflex mechanism for an impulse input.</td>
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<td>2</td>
<td>Develop the simplified model of cardiovascular system and measure the rise time, peak overshoot, settling time and steady state error for the nominal values of L, C and R and compare with the response of diseased person.</td>
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<td>3</td>
<td>Identify the physiological system from the time response analysis for the known input and output conditions.</td>
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<tr>
<td>4</td>
<td>Frequency response analysis and designing of lag/lead compensator for improving the phase margin, gain margin and bandwidth of the light pupil reflex model. Estimate the range of K for stability.</td>
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<tr>
<td>5</td>
<td>Design of controllers (P, PI, PID) for improving time domain specifications of lung mechanics</td>
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PROGRAMMABLE LOGIC CONTROLLERS

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Prerequisites: LD (18EE305)

Course Learning Objectives:
1. To understand the role of PLC in automation and SCADA, hardware capabilities of PLC in industrial automation.
2. To Program a PLC using ladder Diagram, Functional Block Diagram (FBD), Sequential Functions Charts (SFC), Instruction List (IL) and Structured Text (ST) methods
3. To Program a PLC using timers, counters, shift registers, data handling instructions.

UNIT – I

Introduction: Introduction to Programmable logic controller (PLC), SCADA Fundamentals: Introduction, Open system: Need and advantages, Building blocks of SCADA systems, role in automation, advantages and disadvantages, hardware, internal architecture, sourcing and sinking, characteristics of I/O devices, list of input and output devices, examples of applications. I/O processing, input/output units, signal conditioning, remote connections, networks, processing inputs I/O addresses

8 Hours

UNIT – II

Programming: Ladder programming- ladder diagrams, logic functions, latching, multiple outputs, entering ladder programs, functional blocks, program examples, location of stop and emergency switches.

7 Hours

Programming Languages: Instruction list, sequential functions charts, structured text
Internal Relays: ladder programs, battery- backed relays, one - shot operation, set and reset, master control relay, example programs, jump and call subroutines.

9 Hours

UNIT – III

Timers and counters: Types of timers, programming timers, OFF- delay timers, pulse timers, programming examples, forms of counter, programming, up and down counting, timers with counters, sequencer.

8 Hours

Shift register and data handling: shift registers, ladder programs, registers and bits, data handling, arithmetic functions, closed loop control, temperature control and bottle packing applications.

7 Hours

Note: Discussing the programming should be restricted to only one type of PLC (Mitsubhishi)
**Course Outcomes:**
At the end of the course, the student will be able to
1. List and describe characteristics of various I/O devices and interface them to PLC unit
2. Apply suitable logic using various programming languages to achieve specific control mechanism for a given application
3. Use internal relays of PLC to control peripheral devices
4. Identify timer/counter resources of a PLC to design control logic for interfaced device.
5. Choose special functionalities of PLC to control and monitor functions and design the real-world applications

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1: Low 2: Medium 3: High

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**TEXTBOOKS:**

**REFERENCE BOOKS:**

**E Books / MOOC/ NPTEL:**
4. http://nptel.ac.in/courses/112102011/
5. http://nptel.ac.in/courses/112103174/
Prerequisites: BEE (18EE105), I&M (18EE306)

Course Learning Objectives:
1. To know the various aspects of instrumentation.
2. To understand the working principles of various measuring instruments and their characteristics.
3. To comprehend with the working of various transducers.
4. To know the need of Data acquisition, conversion and transmission.

UNIT – I

Instrumentation: Frequency meter, measurement of time and frequency (mains), tachometer, phase meter, capacitance meter. Automation in digital Instrumentation. 7 Hours

Analyzer: Wave analyzers and Harmonic distortion, Basic wave analyzer, Frequency selective wave analyzer, Harmonic distortion analyzer and Spectrum analyzer. 8 Hours

UNIT – II

Measuring Instruments: Output power meters, Field strength meter Vector impedance meter, Q meter applications – Z, Z 0 and Q. Basic LCR bridge, RX meters. 4 Hours

Measurement of power: Measurement of large amount of RF power (calorimetric method), measurement of power on a transmission line, standing wave ratio measurements. 4 Hours

Transducers: Synchro’s, Capacitance Transducers, Load cells, Piezo electrical Transducers, IC type temperature sensors, Pyrometers, Ultrasonic temperature Transducer, Reluctance pulse pick-ups, Flow measurement-mechanical Transducers; Magnetic flow meters, turbine flow meters. β-gauge. 8 Hours

UNIT – III

Data acquisition and conversion: Generalized data acquisition system (DAS), Signal conditioning of inputs, single channel DAS, multi-channel DAS, data loggers, compact data logger. 4 Hours

Data transmission: universal serial bus, IEEE-1394. Long distance data transmission (modems), IEEE 488 bus, Electrical interface. 4 Hours
**Course Outcomes:**
At the end of the course student will be able to
1. Describe the principle of different sensors for the measurement of frequency and phase
2. List various types of signal analyzer to understand the operating principle & applications.
3. Describe the operating principle of various measuring instruments to determine the electrical parameters
4. Illustrate the working principles of various transducers to measure the electrical parameters of physical system
5. Describe the process of data acquisition and conversion for the effective data transmission

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1: Low 2: Medium 3: High

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**REFERENCE BOOKS:**
2. Modern Electronic Instrumentation and Measuring Techniques, Cooper D and A D Helfrick, PHI, 2009

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INDUSTRIAL SERVO CONTROL SYSTEMS

<table>
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<td>Credits</td>
<td>03</td>
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</table>

J- Project Based Learning

**Course Learning Objectives:**
1. To explain the evolution and classification of servos, with descriptions of servo drive actuators, amplifiers, feedback transducers, performance, and troubleshooting techniques.
2. To discuss system analogs and vectors, with a review of differential equations.
3. To represent servo drive components by their transfer function, to combine the servo drive building blocks into system block diagrams.
4. To determine the frequency response techniques for proper servo compensation.
5. To explain perform indices and performance criteria for servo systems.

**UNIT – I**


8 Hours

**Machine Servo Drives:** Types of Drives, Feed Drive Performance.

**Troubleshooting Techniques:** Techniques by Drive, Problems: Their Causes and Cures.

**Machine Feed Drives:** Advances in Technology, Parameters for making Application Choices.


8 Hours

**UNIT – II**

**Generalized Control Theory:** Servo Block Diagrams, Frequency-Response Characteristics and Construction of Approximate (Bode) Frequency Charts, Nichols Charts, Servo Analysis Techniques, Servo Compensation.

**Indexes of Performance:** Definition of Indexes of Performance for Servo Drives, Indexes of Performance Electric and Hydraulic Drives

8 Hours

**Performance Criteria:** Percent Regulation, Servo System Responses.

**Servo Plant Compensation Techniques:** Dead-Zone Non-linearity, Change-in-Gain Non-linearity, Structural Resonances, Frequency Selective Feedback, Feed-forward Control.

**Machine Considerations:** Machine feed drive Considerations, Ball Screw Mechanical Resonances and Reflected Inertias for Machine Drives

7 Hours
UNIT – III

Machine Considerations: Drive Stiffness, Drive Resolution, Drive Acceleration, Drive Speed Considerations, Drive Ratio Considerations, Drive Thrust/Torque and Friction Considerations, Drive Duty Cycles

8 Hours

Course Outcomes:
At the end of the course student will be able to
1. Identify the benefits of servo system and various components to use in hydraulic/electric circuits.
2. Derive differential equations & transfer functions of servosystem to apply in physical systems.
3. Apply the generalized control theory for servo systems to analyze the frequency response.
4. Describe the various performance criteria & servo plant compensation techniques to the servo system.
5. Identify the various machine considerations for servo drive systems.

Course Outcomes Mapping with Program Outcomes & PSO

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1: Low 2: Medium 3: High

SEE Question Paper Pattern:
- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit – I & Unit – II and 1 full question from Unit – III.

TEXTBOOK:

REFERENCE BOOKS:

***************
Syllabus of VII & VIII Semester B.E. / Electrical & Electronics Engineering.

**DISCRETE CONTROL SYSTEM**

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**Prerequisites:** Linear Control System (18EE503)

**Course Learning Objectives:**
1. To model the discrete-time systems by pulse transfer function
2. To study the stability of discrete time systems and the time response of discrete systems.
3. To examine the response of discrete time systems and the controllability observability and stability of discrete state space model.
4. To introduce the concept of state feedback system and the digital control systems with deadbeat response.
5. To analyze the sampled data control systems using root locus and bode plot techniques

**UNIT - I**

**Introduction to digital control:** Introduction, Discrete time system representation, Mathematical modeling of sampling process, Data reconstruction

**Modelling discrete-time systems by pulse transfer function:** Revisiting Z-transform, Mapping of s-plane to z-plane, Pulse transfer function, Pulse transfer function of closed loop system, Sampled signal flow graph.  

8 Hours

**Stability analysis of discrete time systems:** Jury stability test, Stability analysis using bilinear transformation

**Time response of discrete systems:** Transient and steady state responses, Time response parameters of a prototype second order system.  

8 Hours

**UNIT - II**

**Discrete state space model:** Introduction to state variable model, Various canonical forms, Characteristic equation, state transition matrix, Solution to discrete state equation

**Controllability, observability and stability of discrete state space models:** Controllability and observability, Stability, Lyapunov stability theorem.  

8 Hours

**State feedback design:** Pole placement by state feedback, Set point tracking controller, Full order observer, Reduced order observer.

**Deadbeat response design:** Design of digital control systems with deadbeat response, Practical issues with deadbeat response design, Sampled data control systems with deadbeat response  

7 Hours
UNIT - III

Illustration of design procedures of sampled data control systems: Root locus method, Nyquist stability criteria, Bode plot, Controller design using root locus, Lead compensator design using Bode plot, Lag compensator design using Bode plot, Lag-lead compensator design in frequency domain (qualitative) 8 Hours

Course Outcomes:
At the end of the course student will be able to
1. Develop the mathematical modelling of the discrete-time systems to derive the pulse transfer function
2. Analyse the stability & response characteristics of discrete time systems to observe the system performance.
3. Develop various state space model & construct state matrix to solve the state equation.
4. Design the various state feedback system & identify the issues of deadbeat response design to digital control system.
5. Analysediscrete time controllers using root locus and bode plot techniques to evaluate the system stability.

Course Outcomes Mapping with Program Outcomes & PSO

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1: Low 2: Medium 3: High

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TEXTBOOKS:

REFERENCE BOOKS:
2. K. Ogata, Discrete time control system.
E-Books / MOOC
1. NPTEL - Course on Digital Control Systems

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III. ENERGY SYSTEMS

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Course Learning Objectives:
1. To understand the principle of extraction of energy from conventional and non-conventional sources.
2. To familiarize with the operation and applications of solar based thermal, electrical and PV systems
3. To justify the usage of energy storage techniques
4. To discuss the design process and implementation of wind based energy conversion systems
5. To study the process of design and implementation of biomass based energy conversion systems.

UNIT – I

Energy Sources: Introduction, importance of energy consumption as measure of prosperity, Per capita energy consumption, classification of energy resources; conventional energy resources - availability and their limitations; non-conventional energy resources - classification, advantages, limitations; comparison of conventional and non-conventional energy resources; world energy scenario; Indian energy scenario.


Solar PV Systems - stand-alone and grid connected systems; its applications to street lighting, domestic lighting and solar water pumping systems.
UNIT – II

Energy Storage: Introduction, necessity of energy storage, and methods of energy storage (classification and brief description using block diagram representation only).

Wind Energy: Introduction, wind and its properties, history of wind energy, wind energy scenario – world and India. basic principles of wind energy conversion systems (WECS), classification of WECS, parts of a WECS, derivation for power in the wind, electrical power output and capacity factor of WECS, wind site selection consideration, advantages and disadvantages of WECS

Biomass Energy: Introduction, photosynthesis process, biomass fuels, biomass conversion technologies, urban waste to energy conversion, biomass gasification, biomass to ethanol production, biogas production from waste biomass, factors affecting biogas generation, types of biogas plants – KVIC and Janata model; biomass program in India.

UNIT – III

Energy from Ocean: Tidal energy – Principle of tidal power, components of tidal power plant (TPP), classification of tidal power plants, estimation of energy – single basin and double basin type TPP(no derivations. simple numerical problems), advantages and limitation of TPP. ocean thermal energy conversion (OTEC): principle of OTEC system, methods of OTEC power generation – open cycle (Claude cycle), closed cycle (Anderson cycle) and hybrid cycle (block diagram description of OTEC); site-selection criteria, biofouling, advantages & limitation of OTEC

Emerging Technologies: Fuel cell, small hydro resources, hydrogen energy and wave energy. (principle of energy generation using block diagrams, advantages and limitations).

Course Outcomes:
At the end of the course student will be able to
1. Describe nonconventional energy sources and solar radiation geometry to estimate & measure solar radiation.
2. Apply the principle of solar radiation into heat to understand the operation of solar thermal and solar electric systems.
3. Describe energy storage methods and wind-energy conversion systems to understand the factors influencing power generation.
4. Apply the biomass conversion technology to design biomass based energy systems.
5. Describe tidal, ocean thermal and fuel cell energy conversion systems to understand emerging renewable energy technologies.
### Course Outcomes Mapping with Program Outcomes & PSO

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### TEXTBOOKS:

### REFERENCE BOOKS:

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ENERGY AUDIT & DEMAND SIDE MANAGEMENT

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**Course Learning Objectives:**
1. To determine the demand, profile of usage and techniques of energy measurement
2. To understand the power distribution for economic development of the nation.
3. To understand the parameters of electrical system optimization
4. To introduce and analyze various techniques of demand side management.
5. To be familiarized with load management & different electrical tariff systems

**UNIT – I**

**Introduction:** Energy situation – world and India, energy consumption, conservation. codes, standards and legislation. **5 Hours**

**Energy Economic Analysis:** The time value of money concept, developing cash flow models, Payback analysis, depreciation, taxes and tax credit –problems. **5 Hours**

**Energy Auditing:** Introduction, elements of energy audits, energy use profiles, measurements in energy audits, presentation of energy audit results. **5 Hours**

**UNIT – II**

**Electrical System Optimization:** The power triangle, motor horsepower, power flow concept, electrical equipment and power factor –correction & location of capacitors. **5 Hours**

**Demand Side Management:** Introduction to DSM, concept of DSM, benefits of DSM, different techniques of DSM – time of day pricing, multi-utility power exchange model and time of day models for planning. **10 Hours**

**UNIT – III**

**Energy efficient motors, Lighting basics, Electrical rate tariff:** Load management, load priority technique, peak clipping, peak shifting, valley filling, strategic conservation, energy efficient equipment. **9 Hours**

**Course Outcomes:**
At the end of the course student will be able to
1. Estimate energy consumption & conservation by suggesting installation modification to compute payback period.
2. Measure and collect data to present energy audit results.
3. Analyze the power flow based on motor horsepower to suggest power factor correction.
4. Apply various techniques to implement demand side management.
5. Evaluate load management methods to manage the load using energy efficient equipment.
**Course Outcomes Mapping with Program Outcomes & PSO**

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**TEXTBOOKS:**

**REFERENCE BOOKS:**
2. Hand book on energy auditing - TERI (Tata Energy Research Institute)

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**ELECTRICAL POWER QUALITY**

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**Prerequisites:** PSAS (18EE601), PE (18EE504)

**Course Learning Objectives:**
1. To introduce the concept of power quality and their classes.
2. To illustrate the voltage sags and interruptions, their sources, estimation & protection
3. To analyze the transient over voltages, fundamentals of harmonics, harmonic sources & effects of harmonic distortions.
4. To discuss power quality bench marking process and utility interface
5. To review the monitoring considerations and standards.
UNIT – I

Definitions: General classes of power quality problems, Transients, long duration voltage variation, short duration voltage variations, voltage imbalance, waveform distortion, power quality terms

3 Hours
Voltage sags and interruptions: Sources of sags and interruptions, estimating voltage sag performance, fundamental principles of protection, monitoring sags.

5 Hours

Transients over voltages: Sources of transient over voltages, principles of overvoltage protection, utility capacitor switching transients, fundamentals of harmonics: harmonic distortion, voltage versus transients, harmonic indexes, harmonic sources from commercial loads, harmonic sources from Industrial loads, effects of harmonic distortion, intra-harmonics

8 Hours

UNIT – II

Applied harmonics: harmonic distortion evaluations, principles for controlling harmonics, harmonic studies, devices for controlling harmonic distortion, harmonic filters, standards of harmonics

7 Hours

Power quality benchmark: introduction, benchmark process, power quality contract, power quality state estimation, including power quality in distribution planning, Interface to utility system, power quality issues, interconnection standards

8 Hours

UNIT – III

Power quality monitoring: Monitoring considerations, power quality measurement equipments, assessment of power quality measurement data, application of intelligent systems and power quality monitoring standards.

8 Hours

Course Outcomes:
At the end of the course student will be able to
1. Describe various power quality issues to estimate voltage sag and performance.
2. Analyze transient over voltages & harmonics to understand the factors affecting the power quality
3. Describe the principle for controlling the harmonics and filters to meet the standards
4. Analyze the power quality bench marking process and power quality contract to solve power quality issues.
5. Identify the Monitoring considerations, standards, measurement equipment, and application of intelligent systems.
Course Outcomes Mapping with Program Outcomes & PSO

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TEXTBOOK:

REFERENCE BOOKS:

INTEGRATION OF DISTRIBUTED GENERATION SYSTEMS

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Course Learning Objectives:
1. To explain power generation by alternate energy source like wind power and solar power.
2. To explain selection of size of units and location for wind & solar systems.
3. To study the effects of integration of distributed generation on the performance of the system.
4. To provide practical and useful information about grid integration of distributed generation.
5. To understand impact of integration of DG on power system stability and operation.
UNIT – I

**Distributed Generation**: Introduction, status, properties of wind power, power distribution as a function of wind speed, solar power: status, properties, space requirements, photovoltaic’s, seasonal variation in production capacity, combined heat-and-power: status, options for space heating, hydropower: properties of large hydro, properties of small hydro, variation with time, tidal power, wave power, geothermal power, thermal power plant.

7 Hours

**Distributed Generation (continued)**: Interface with the grid, power system performance: impact of distributed generation on the power system, aims of the power system, hosting capacity approach, power quality, voltage quality and design of distributed generation, hosting capacity approach for events, increasing the hosting capacity.

4 Hours

**Overloading and Losses**: Impact of distributed generation, overloading: radial distribution networks, active power flow only, active and reactive power flow overloading: redundancy and meshed operation redundancy in distribution networks, meshed operation, losses.

4 Hours

UNIT – II

**Overloading and Losses (continued)**: Increasing the hosting capacity: increasing the loadability building new connections, inter trip schemes, advanced protection schemes, energy management systems. power electronics approach, demand control, prioritizing renewable energy, dynamic loadability.

**Voltage Magnitude Variations**: Impact of distributed generation, voltage margin and hosting capacity: voltage control in distribution systems, voltage rise owing to distributed generation, hosting capacity, estimating hosting capacity without measurements, sharing hosting capacity.

**Design of Distribution Feeders**: Basic design rules, terminology, an individual generator along a medium-voltage feeder, low voltage feeders, series and shunt compensation, a numerical approach to voltage variations: example for two-stage boosting, general expressions for two-stage boosting tap changers with line-drop compensation: transformer with one single feeder, adding a generator. probabilistic methods for design of distribution feeders: need for probabilistic methods, the system studied, generation with constant production, adding wind power.

6 Hours

**Voltage Magnitude Variations (continued)**: Statistical approach to hosting capacity, increasing the hosting capacity: new or stronger feeders, alternative methods for voltage control accurate measurement of the voltage magnitude variations, allowing higher overvoltage’s overvoltage protection, over voltage curtailment compensating the generators voltage variations, distributed generation with voltage control, coordinated voltage control.

5 Hours

**Power Quality Disturbances**: Impact of distributed generation, fast voltage fluctuations: fast fluctuations in wind power, fast fluctuations in solar power, rapid voltage changes, very short variations. voltage unbalance: weaker transmission system, stronger...
distribution system, large single-phase generators, stronger distribution grid voltage unbalance.  

UNIT – III

Power Quality Disturbances (continued): Low-frequency harmonics: wind power: induction generators, generators with power electronics interfaces, synchronous generators, measurement example, harmonic resonances, weaker transmission grid, and stronger distribution grid. High-frequency distortion: emission by individual generators, grouping below and above 2 kHz, limits below and above 2 kHz, voltage dips: synchronous machines balanced dips and unbalanced dips, induction generators and unbalanced dips, increasing the hosting capacity: strengthening the grid, emission limits for generator units, emission limits for other customers, higher disturbance levels, passive harmonic filters, power electronics converters, reducing the number of dips, broadband and high-frequency distortion.

Course Outcomes:  
At the end of the course the student will be able to:  
1. Describe solar, wind, hydro and tidal power generation to understand the concepts of distributed generation  
2. Analyze the system performance on integrating the distributed generation system with the grid  
3. Analyze the effects of the DG integration to determine the increased risk of overload and system losses  
4. Describe the effects of DG integration to study the impact of power quality issues.  
5. Analyze the power quality disturbance to understand the impact of voltage dips on system load.

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1: Low 2: Medium 3: High

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- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit – I & Unit – II and 1 full question from Unit – III.

TEXTBOOK:  

***************
Syllabus of VII & VIII Semester B.E. / Electrical & Electronics Engineering.

ILLUMINATION TECHNOLOGY

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Course Learning Objectives:
1. To understand the importance of Light
2. To comprehend the propagation of light & photometric units
3. To demonstrate the process of production of radiation and their characteristics
4. To enumerate the principle of artificial light sources.
5. To design the objectives and methods for Interior lighting.

UNIT – I


UNIT – II


UNIT – III

Interior Lighting Design: Lighting design objectives–safely and health performance–appearance & comport lighting design flow chart. Lighting for commercial and public buildings such as offices, hotels teaching establishments and hospital lighting. Lighting for industrial buildings, low & high bay area’s general lighting designs. Lighting for display– Shops & supermarkets, art galleries, museum lighting, lumen method of calculations–simple problems.

6 Hours
Light and health: light as radiation, tissue damage by ultraviolet radiation, Tissue Damage by Visible and Near Infrared Radiation, Tissue Damage from Infrared Radiation beyond 1400 nm, Threshold Limit Values, Practical Considerations, Aging Effects, Risk of Exceeding Limits, Using Task Lights, Eyestrain, Migraine, Autism, Visual Comfort and Human Variability, Light Operating through the Circadian System, Sleep, blue light hazard.

3 Hours

Course Outcomes:
At the end of the course student will be able to
1. Analyze the electromagnetic spectrum of light to justify the concepts of vision systems.
2. Describe the light propagation principle to illustrate the photometric parameters
3. Describe the process of radiation to analyze and distinguish color rendering properties.
4. Apply the concept of artificial light sources to suggest efficient lighting system.
5. Design lighting systems to suggest interior and exterior in-addition to health safety.

Course Outcomes Mapping with Program Outcomes & PSO

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- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit – I & Unit – II and 1 full question from Unit – III.

TEXTBOOK:

REFERENCE BOOKS:
Course Learning Objectives:
1. To understand the solar radiation and PV technologies
2. To familiarize with PV inverters and mounting methods of PV systems
3. To examine the site assessment, design process of the grid connected system and its sizing.
4. To know the procedures of installation, commissioning and maintenance of PV systems.
5. To discuss the types of financial incentives available, calculation of payback time

UNIT – I

Solar Resource and Radiation: Solar resources, quantifying solar radiation, the effect of the Earth’s atmosphere on solar radiation, Sun geometry, Geometry for installing solar arrays.

3 Hours


3 Hours

PV Cells, Modules and Arrays: Characteristics of PV cells, Graphic representations of PV cell performance, Connecting PV cells to create a module, Specification sheets, creating a string of modules, Creating an array, Photovoltaic array performance, Irradiance, Temperature, Shading

2 Hours

Inverters and Other System Components: Introduction, Inverters, Battery inverters, Grid-interactive inverters, Transformers, Mainstream inverter technologies, String inverters, Multi-string inverter, Central inverter, Modular inverters, Inverter protection systems, Self-protection, Grid protection, Balance of system equipment: System equipment excluding the PV array and inverter, Cabling, PV combiner box, Module junction box, Circuit breakers and fuses, PV main disconnects/isolators, Lightning and surge protection, System monitoring, Metering, Net metering, Gross metering.

4 Hours

Mounting Systems: Roof mounting systems, Pitched roof mounts, Pitched roof mounts for tiled roofs, Pitched roof mounts for metal roofs, Rack mounts, Direct mounts, Building-integrated systems, Ground mounting systems, Ground rack mounts, Pole mounts, Sun-tracking systems, Wind loading, Lightning protection

3 Hours
UNIT - II

Site Assessment: Location of the PV array, Roof specifications, Is the site shade-free?, Solar Pathfinder, SolmetricSuneye, HORI catcher, iPhone apps, Software packages, Available area, Portrait installation, Landscape installation, Energy efficiency initiatives, Health, safety and environment (HSE) risks, Local environment, Locating balance of system equipment, Site plan.

3 Hours


2 Hours

Sizing a PV System: Introduction, Matching voltage specifications, Calculating maximum voltage, Calculating minimum voltage, Calculating the minimum number of modules in a string, Calculating the maximum voltage, Calculating the maximum number of modules in a string, Calculating the minimum voltage, Calculating the minimum number of modules in a string, Matching current specifications, Matching modules to the inverter's power rating, Losses in utility-interactive PV systems, Temperature of the PV module, Dirt and soiling, Manufacturer's tolerance, Shading, Orientation and module tilt angle, Voltage drop, Inverter efficiency, Calculating system yield.

3 Hours

Installing Grid-connected PV Systems: PV array installation, DC wiring, Cabling routes and required lengths, Cable sizing, PV combiner box, System grounding/earthing, Inverter installation, Installation checklist, Interconnection with the utility grid, required information for installation, Safety.

3 Hours


2 Hours

System Operation and Maintenance: System maintenance, PV array maintenance, Inverter maintenance, System integrity, Troubleshooting, Identifying the problem, Troubleshooting PV arrays, troubleshooting underperforming systems, Troubleshooting inverters, other common problems.

3 Hours

UNIT - III


4 Hours

Case Studies: Case studies A to G

4 Hours
**Course Outcomes:**
At the end of the course student will be able to
1. Describe basic concepts of solar cell to illustrate PV technologies
2. Describe various PV inverter topologies & to suggest the methods of mounting the PV panels
3. Describe the factors related to site assessment to design the grid connected systems.
4. Outline the process of PV installation and commissioning to operate & maintain the PV systems.
5. Analyze the economics of grid connected PV systems to calculate the payback time.

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**TEXTBOOKS:**

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ELECTRICAL POWER UTILIZATION

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**Prerequisites:** Basic Electrical Engineering (18EE105), Instrumentation and Measurements (18EE306), DC and Synchronous machines (18EE303)

**Course Learning Objectives:**
1. To understand the types and working of various heating and welding equipments.
2. To be familiarized with the electrolysis process and its control using electrical power.
3. To select different traction equipments based on their characteristics and to control them.
4. To introduce to Illumination, its requirements and study the construction & working of different types of lamps.
5. To introduce electric and hybrid vehicles and associated technologies.

**UNIT – I**

**HEATING AND WELDING:** Advantages and methods of electric heating, resistance ovens, induction heating, dielectric heating, the arc furnace, heating of building, electric welding, resistance and arc welding, control device and welding equipment

9 Hours

**ELECTROLYTIC PROCESS:** Fundamental principles, extraction, refining of metals, electroplating. Factors affecting electro deposition process, power supply for electrolytic process.

7 Hours

**UNIT – II**

**ELECTRIC TRACTION:** System of traction, speed time curve, tractive effort at /co-efficient of adhesions, selection of traction motors, method of speed control, energy saving by series parallel control

7 Hours

**AC TRACTION EQUIPMENT:** AC series motor, characteristics, regenerative braking, linear induction motor and their use. AC traction, diesel electric equipment, train lighting system, specific energy, factors affecting specific energy consumption.

7 Hours

**UNIT – III**

**ILLUMINATION:** Laws of illumination, lighting calculation, factory lighting, flood lighting, street lighting, different types of lamps, incandescent, fluorescent, vapor and CFL and their working, Glare and its remedy

6 Hours

**INTRODUCTION ELECTRIC AND HYBRID VEHICLES:**
Configuration and performance of electrical vehicles, traction motor characteristics, tractive effort, transmission requirement, vehicle performance and energy consumption

3 Hours

Course Outcomes:
At the end of the course student will be able to
1. List the various methods of electrical heating and welding to select an appropriate method for a given application.
2. Describe the fundamental principles of electrolytic processes of extraction and refinement of metals
3. Select and control electric motors for traction to achieve energy savings.
4. Analyze the characteristics of AC traction motors, train lighting system and compute specific energy consumption.
5. Apply fundamentals of illumination to design lighting for a given application and outline the transmission requirements of EVs.

Course Outcomes Mapping with Program Outcomes & PSO

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TEXTBOOKS:

REFERENCE BOOK:

**********************
Course Learning Objectives:

1. To explain construction, classification of industrial furnaces
2. To know the different processes of heat transfer in industrial furnaces
3. Explicate the heating capacity of continuous furnaces.
4. Discuss the methods of saving energy in industrial furnace systems
5. Explain the operation and control of industrial furnaces.

UNIT – I


7 Hours

Heating Capacity of Batch Furnaces: Definition of Heating Capacity, Effect of Rate of Heat Liberation, Effect of Rate of Heat Absorption by the Load, Effect of Load Arrangement, Effect of Load Thickness, Vertical Heating, Batch Indirect-Fired Furnaces, Batch Furnace Heating Capacity Practice, Controlled Cooling in or After Batch Furnaces.

8 Hours

UNIT – II

Heating Capacity of Continuous Furnaces: Continuous Furnaces Compared to Batch Furnaces, Continuous Dryers, Ovens, and Furnaces for <1400 F (<760 C), Continuous Midrange Furnaces, 1200 to 1800 F (650 to 980 C), Sintering and Pelletizing Furnaces, Axial Continuous Furnaces for Above 2000 F (1260 C), Continuous Furnaces for 1900 to 2500 F (1038 to 1370 C), Continuous Liquid Heating Furnaces.

7 Hours


8 Hours

UNIT – III

Operation and Control of Industrial Furnaces: Burner and Flame Types, Location, Flame Fitting, Unwanted NOx Formation, Controls and Sensors—Care, Location, Zones, Air/Fuel Ratio Control, Furnace Pressure Control, Turndown Ratio, Furnace Control Data Needs,
Soaking Pit Heating Control, Uniformity Control in Forge Furnaces, Continuous Reheat Furnace Control. 9 Hours

Course Outcomes:
At the end of the course the student will be able to:
1. Describe the heating process and industrial furnace to outline the construction and classification
2. Describe batch furnaces to study the methods of heat transfer in industries
3. Describe the operation of continuous furnaces to compare with the batch furnaces.
4. Analyze the methods of saving energy to calculate fuel consumption & energy costs in industrial furnace systems
5. Describe the operation of industrial furnaces to control furnaces using sensors.

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TEXTBOOK:

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IV. POWER SYSTEM

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Prerequisites: PE (18EE504), T&D (18EE406), PSAS (18EE601)

Course Learning Objectives:
1. To introduce concepts of HVDC and HVAC generation transmission and comparison between them.
2. To choose converter and their control configuration for HVDC power transmission and their configuration.
3. To illustrate the bridge converter under different modes of operation.
4. To explain the various methods to Control the HVDC converters.
5. To identify different types of protection used for HVDC system.

UNIT – I

General aspects of DC transmission and comparison of it with Ac transmission: Historical sketch, constitution of EHV AC and DC links, Limitations and Advantages of AC and DC Transmission,

8 Hours

Converter circuits: Valve Characteristics, Properties of converter circuits, assumptions, single phase, three phase converters, choice of best circuits for HV DC circuits.

7 Hours

UNIT – II

Analysis of the bridge converter:- Analysis with grid control but no overlap, Analysis with grid control and with overlap less than 60 deg, Analysis with overlap greater than 60 deg, complete characteristics of rectifier, Inversion.

8 Hours

Control of HVDC converters and systems: grid control, basic means of control, power reversal, limitations of manual control, constant current versus constant voltage, desired feature of control, actual control characteristics, constant –minimum –Ignition – angle control, constant –current control, constant –extinction –angle control, stability of control.

8 Hours

UNIT – III

Protection: general, DC reactor, voltage oscillations and valve dampers, current oscillations and anode dampers, DC line oscillations and line dampers, clear line faults and reenergizing the line.

9 Hours
Course Outcomes:
At the end of the course student will be able to
1. Compare the HVDC and HVAC transmission systems to list out the advantages and disadvantages.
2. Analyze different converter circuits configuration to select best converter configuration for HVDC power transmission
3. Analyze bridge converter for different modes of operation without and with overlap
4. Apply different techniques for control the HVDC converters
5. Describe different types of protection schemes used in HVDC transmission system.

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TEXTBOOK:

REFERENCE BOOKS:

E-Books / MOOC / NPTEL
1. http://nptel.ac.in/courses/108104013/
Course Learning Objectives:
1. To study the Information and Communication Technologies related to smart grid.
2. To understand the Information security and different sensing and automation techniques.
3. To know the principles of Distribution management systems and transmission system operation for smart equipment's.
4. To study the power quality issues and their management in smart grid
5. To know the importance of micro grids and distributed energy resources.

UNIT – I

The Smart Grid: Introduction, Overview of the technologies required for the Smart Grid.

Information and Communication Technologies: Data communication, Switching techniques, Communication channels, layered architecture and protocols Ethernets, Wireless Lan, Bluetooth and Zigbee communication technology.

Information security for the Smart Grid - Introduction, Encryption and decryption, Authentication, Digital signatures, Cyber security standards

Sensing, Measurement, Control and Automation Technologies: Smart metering - An overview of the hardware used, Communications infrastructure and protocols for smart metering.

UNIT – II

Distribution automation equipment and Management systems - Introduction, Data sources and associated external systems, Modelling and analysis tools,

Transmission system operation - Phasor measurement UNIT s, Wide area applications.

Power electronics in Smart Grid - Introduction, Renewable energy generation, Photovoltaic systems, Wind, hydro and tidal energy systems, Fault current limiting.

UNIT – III

Course Outcomes:
At the end of the course student will be able to
1. Identify various Information and Communication Technologies to learn the usage in electric grid.
2. Illustrate the Information security and automation techniques for protection and automation of smart electric grid.
3. Describe the principles of Distribution management systems and transmission system operation for smart equipment's.
4. Illustrate the interfacing of power electronics devices to learn integration renewable energy sources to smart grid.
5. Describe power quality issues, power conditioners and monitor system to monitor the health of smart electric grid.

Course Outcomes Mapping with Program Outcomes & PSO

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TEXTBOOK:

REFERENCE BOOKS:
7. Tony Flick and Justin Morehouse, “Securing the Smart Grid”, Elsevier Inc.
Prerequisites: PSAS (18EE601), SGP (18EE602)

Course Learning Objectives:
1. To introduce various static relays used in PS protection.
2. To illustrate the need of Comparators and list out various comparators and their characteristics.
3. To explain the concept of static over current, timer and voltage relays.
4. To illustrate the use and implementation of distance relays.
5. To explain the Principles of Digital/ Numerical Relays

UNIT – I

Static Relays: Introduction, Basic construction, Classification, Basic Circuits, Smoothing Circuits, Voltage regulation, square wave Generator, Time delay Circuits, Level Detectors, Summation device, Sampling Circuits, Zero crossing detector, output devices.

7 Hours

Comparators: Replica impedance, Mains Transformers, General equation of phase and Amplifiers, Comparators, Realization of ohm, mho, Impedance and offset impedance characteristics, Dualist principal, Static amplifier comparator – Rectifier bridge circulations current type, sampling comparator, static phase comparator accident circuits type Rectifier phase comparator, Block split comparator, Zen or diode phase comparator

8 Hours

UNIT – II

STATIC OVER CURRENT, TIMER AND VOLTAGE RELAYS:
Instantaneous over current Relay, Definite time lay relay, inverse time over current relay, static timer relay, Basic relay circuits, mono stable delay circuits Single phase Instantaneous over voltage and under voltage relays, instantaneous over voltage relay using Op amp.

8 Hours

Distance Relay: general Principal of operation, Zone discrimination, Fault area on impedance diagram, Basic measuring elements, Different characteristics used in distance relaying- Impedance, Reactance, Admittance. Ohm, Distance relay settings, Distance measurement Problems.

7 Hours

UNIT – III

Principles of Digital/ Numerical Relays: Definition of Numerical Protection System, Advantages of Numerical relays, Block diagram of Numerical Relays, Processing Unit,
non-machines Interface, communication in protective relays, Information handling with substation monitoring system.

**Digital Relays:** Block Schematic approach of microprocessor-based relays, over current relay, Protection Transformer differential protection, Directional relay scheme, Impedance relay scheme.

**4 Hours**

**5 Hours**

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

1. Describe the basic components to understand the construction and working of static relay
2. Apply general equation phase and amplitude comparators to realize the different relay characteristics.
3. Describe static relay circuits for protection against over current, over voltage and under voltages
4. Analyze different distance relays for zone and directional discrimination.
5. Describe the Principle of operation of Digital/ Numerical Relays utilized in various relay protection schemes.

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**TEXTBOOKS:**
Syllabus of VII & VIII Semester B.E. / Electrical & Electronics Engineering.

REFERENCE BOOKS:

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<th>POWER SYSTEM PLANNING</th>
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Prerequisites: GTD (18EE405), PSAS (18EE601)

Course Learning Objectives:
1. To discuss primary components of power system planning namely load forecasting, evaluation of energy resources
2. To explain planning methodology for optimum power system expansion, various types of generation, transmission and distribution
3. To discuss evaluation of operating states of transmission system, their associated contingencies and determination of the stability of the system for worst case conditions
4. To discuss reliability criteria for generation, transmission, distribution and reliability evaluation and analysis.
5. To discuss planning and implementation of electric utility activities designed to influence consumer uses of electricity.

UNIT – I


Electricity Forecasting: Load Requirement, System Load, Electricity Forecasting, Forecasting Techniques, Forecasting Modelling, Spatial – Load Forecasting, Peak Load – Forecast, Reactive – Load Forecast, Unloading of a System


Generation Expansion: Generation Capacity and Energy, Generation Mix, Conventional
Syllabus of VII & VIII Semester B.E. / Electrical & Electronics Engineering.

Generation Resources, Nuclear Energy, Clean Coal Technologies, Distributed Power Generation, Renovation and Modernisation of Power Plants.  
4 Hours

UNIT – II

4 Hours

6 Hours

5 Hours

UNIT – III

4 Hours

4 Hours

Course Outcomes:
At the end of the course student will be able to
1. Describe primary components of power system planning, load forecasting for forecasting of future load requirements of both demand and energy by deterministic and statistical techniques using forecasting tools
2. Apply planning methodology for optimum power system expansion, various types of generation, transmission and distribution
3. Evaluate the operating states of transmission system, their associated contingencies and determination of the stability of the system for worst case conditions
4. Describe reliability criteria for generation, transmission, distribution & reliability evaluation and analysis.
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### TEXTBOOK:

### POWER SYSTEM OPERATION AND CONTROL

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Prerequisites: NA (18EE405), GTD (18EE405), PSAS (18EE601), DCSM (18EE303)

Course Learning Objectives:
1. Explain the importance of Control Center and SCADA system in Power system operation.
2. Study the operation of Automatic Generation Control system in Power system.
3. Understand the generation and absorption of reactive power and methods of voltage control.
4. Understand the importance and study of various methods of UNIT commitment.
5. Study the various factors affecting the Power system security and contingency analysis.

### UNIT – I

CONTROL CENTER OPERATION OF POWER SYSTEMS:
Introduction to SCADA, control center, digital computer configuration, automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators.  

8 Hours

AUTOMATIC GENERATION CONTROL:
Automatic voltage regulator, automatic load frequency control, AVR control loops of generators, performance of AVR, ALFC of single area systems, concept of control area, multi-area systems, POOL operation–two area systems.

8 Hours
UNIT – II

CONTROL OF VOLTAGE AND REACTIVE POWER: Introduction, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, single machine infinite bus systems, methods of voltage control, sub synchronous resonance, voltage stability, voltage collapse.

UNIT COMMITMENT: Statement of the problem, need and importance of UNIT commitment, methods-priority lists method, dynamic programming method, constraints, spinning reserve, and examples.

UNIT – III

POWER SYSTEM SECURITY Factors affecting power system security, power system contingency analysis, detection of network problems, network sensitivity methods, calculation of network sensitivity factor, contingency ranking.

Course Outcomes:
At the end of the course student will be able to
1. Describe the control Centre operation of power system to understand the tie line power flow and frequency deviation
2. Analyze the effect of Automatic Voltage Regulator and Automatic Generation Control on Load Frequency Control of single and two area systems
3. Analyze the effect of reactive power control on Voltage stability and voltage collapse at a load bus
4. Apply various methods unit commitment for optimum operation of generation systems
5. Analyze the various factors affecting the security power system for contingency ranking.

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TEXTBOOKS:

REFERENCE BOOKS:

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FLEXIBLE AC TRANSMISSION SYSTEMS (FACTS)

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Prerequisites: PE (18EE504), GTD (18EE405), PSAS (18EE601)

Course Learning Objectives:
1. Explain and understand the concept of various FACTS Controllers for power flow control
2. Study the requirement and importance of different High power Semiconductor devices and VSC for control of power Flow
3. Study the application and control of self and line commutated current source Converters
4. Study the control of shunt compensation by passive and active shunt FACTS controllers for enhancement of power transfer capability and damping of power oscillations.
5. Study the application of series FACTS controllers for controlling / routing the power through the desired transmission paths

UNIT – I

FACTS Concepts and general system configuration: Transmission, interconnection, flow of power in AC system, power flow and dynamic stability consideration, of a transmission interconnection, relative importance of controllable parameters, basic types of FACTs controllers, shunt, series, combined shunt and series connected controllers.

9 Hours

UNIT – II

POWER SEMICONDUCTOR DEVICES: Types of high power devices, principle of high power device characteristics and requirements, IGBT and GTO devices.

3 Hours

VOLTAGE SOURCED CONVERTERS: Basic concepts, single phase full wave bridge converter operation, and square wave voltage harmonics for a single-phase bridge 3 phase full wave bridge converter.

4 Hours
SELF AND LINE COMMUTATED CURRENT SOURCE CONVERTER: Basic concepts, 3 phase full wave diode rectifier, thyristor-based converter, current sourced converter with turnoff devices, Current sourced versus voltage source converter.  

SHUNT COMPENSATION: Objectives, Midpoint voltage regulation for line segmentation, End of line voltage support to prevent voltage instability, Improvement of transient stability, power oscillation damping.

UNIT – III

STATIC SHUNT COMPENSATOR SVC AND STATCOM: Methods of controllable VAR generation, static VAR compensator, STATCOM, comparison between SVC and STATCOM.

STATIC SERIES COMPENSATORS: Objectives of series compensation; variable impedance type of series compensation, GCSC, TSSC, TCSC. Switching converter type series compensation- SSSC, external control for series reactive compensators, application of static series compensation for improvement of transient stability and power oscillation damping.

Course Outcomes:
At the end of the course student will be able to
1. Describe various FACTS controllers required for control of active and reactive power flow in a transmission network.
2. Compare various High-power Semiconductor devices and analyze the working of Voltage Sourced Converters (VSC) and Current Sourced Converters (CSC) for active and reactive power flow control.
3. Design Shunt compensation schemes for the improvement of transient stability and damping of power oscillations
4. Analyze the working of static shunt compensation schemes using SVC and STATCOM for voltage and reactive power control
5. Analyze various series compensation schemes using variable impedance and VSC based series FACTS controllers for controlling / routing the power through the desired transmission paths.

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REFERENCE BOOK:

E Book / MOOC/NPTEL
1. NPTEL Course on “FACTS DEVICES” by Dr. Avik Bhattacharya, IIT Roorkee

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### AI APPLICATIONS TO POWER SYSTEMS

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**Course Learning Objectives:**
1. To study the Difference between Algorithmic based methods and knowledge-based methods
2. To understand the use of the soft computing techniques for voltage control problems.
3. To know the appropriate AI framework for solving power system protection problems.
4. To study the different AI techniques for demand forecasting
5. To know the Adaptive AI techniques in the power system protection and control

**UNIT – I**

**Introduction:** Definition of AI difference between soft computing techniques and hard computing systems, expert systems brief history of ANN, Fuzzy and GA.

3 Hours

**Fuzzy logic and Hybrid systems:** Concept of Fuzzy in Power system, Fuzzy Techniques and Applications in power system.

4 Hours

**Comparison among various Artificial Intelligence Techniques:** ANN, Fuzzy, Evolutionary algorithms, Expert systems. Hybrid systems: Fuzzy expert system Hybrid, Neural Network system Hybrid. Application in Power system.

4 Hours
Artificial Intelligence techniques for voltage control:
Introduction, Algorithm methods, Voltage collapse monitoring, Reactive power management, Combined active and reactive dispatch. AI techniques for Voltage control 4 Hours

UNIT – II

AI Techniques for protection systems: Introduction: An expert system for Protective relaying settings, Fuzzy logic for power system protection. Artificial neural network in phase selection. 2 Hours

Artificial Neural network for static security assessment: Introduction to power system security assessment, AI techniques to power system security assessment- Fuzzy techniques, ANN 3 Hours

A supervised ANN for power system security prediction: ANN Architecture, Training set selection, A new prediction performance measure, ANN performance evaluation. 3 Hours

Intelligence systems for demand forecasting: Introduction, stages in building a forecast model, Identifying the model, survey of intelligence system for demand forecasting. 8 Hours

UNIT – III

A practical application and implementation of adaptive techniques using neural networks into auto-reclose protection and system control: Introduction, Auto recloser description: conventional scheme, Adaptive reclose description, neural network description, system simulation, fault records, feature extraction, Neural Network training, Neural Network testing. 8 Hours

Course Outcomes:
At the end of the course student will be able to
1. List the various soft computing and hard computing techniques to apply in power system
2. Compare different AI techniques to choose an appropriate methods for voltage control in power system
3. Select appropriate AI framework for solving power system protection problems.
4. Describe various AI techniques for demand forecasting.
5. Describe the Adaptive AI techniques to apply in power system protection and control

Course Outcomes Mapping with Program Outcomes & PSO

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1: Low 2: Medium 3: High
SEE Question Paper Pattern:
- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit - I & Unit - II and 1 full question from Unit – III.

TEXTBOOKS:

REFERENCE BOOKS:
1. Introduction to Artificial Intelligence and Expert System by Dan W Patterson, PHI

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Prerequisites: PSAS (18EE601), DCSM (18EE303)

Course Learning Objectives:
1. To understand the system modelling and dynamics of synchronous generator
2. To model the load connected to power system and analyze its small signal stability
3. To introduce various excitation and prime mover controllers
4. To model various prime movers
5. To carry out transient analysis of power system and understand the importance of stability controllers

UNIT – I

System Modeling and Dynamics of Synchronous Generator: Basic concepts, Review of classical methods, modeling of synchronous machine, Swing equation, Park’s transformation – Park’s voltage equation, Park’s mechanical equation (torque). Applications – (a) Voltage build up in synchronous machine, and (b) Symmetrical short circuit of generator. Solution for transient analysis, Operational impedance, Relationship between $T_{do}$’ and $T_{do}''$ 8 Hours

Load Modeling: Introduction, Two approaches – Polynomial model and Exponential model. Small Signal Angle Stability: Small signal angle stability with SMIB system, detailed model of SMIB 7 Hours
UNIT – II

**Excitation and Prime Mover Controllers:** Introduction, Types of excitation, AVR with and without ESS, TGR, Amplifier PSS, Static exciters.  **8 Hours**

**Modeling of Prime Movers:** Introduction, Three major components, Block diagram, Hydraulic turbine, Steam turbine.  **8 Hours**

UNIT – III

**Transient Stability Analysis:** Simulation for Transient stability Evaluation, Transient stability controllers.  **8 Hours**

**Course Outcomes:**
At the end of the course student will be able to
1. Model the synchronous generator for understanding its dynamics.
2. Apply techniques to model the load to understand the dynamics of load and SMIB system.
3. Describe the concept of excitation and prime mover controllers used in the voltage regulation.
4. Describe the various components to model the prime mover.
5. Perform the transient stability analysis to understand the importance of stability controller.

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**TEXTBOOKS:**
REFERENCE BOOKS:

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REACTIVE POWER MANAGEMENT

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Prerequisites: NA (18EE405), T&D (18EE406), PSAS (18EE601)

Course Learning Objectives:
1. To introduce the concept of reactive power, its generation and absorption in power system.
2. To illustrate various methods of voltage or reactive power control.
3. To demonstrate the principle of transmission system compensation, Effect of harmonics on reactive power control.
4. To comprehend the concept of resonance, shunt capacitors and filters.
5. To explain the reactive power coordination techniques.

UNIT – I

Introduction, Importance of reactive power control in Electrical Power System, Generation and absorption of Reactive power, Relation between Voltage, Power and Reactive power at a node.

Methods of voltage or Reactive power control: Shunt reactor, Shunt capacitor, Series capacitor, Synchronous condenser, Static VAR system

UNIT – II

Principles of Transmission system compensation, Effect of Harmonics on reactive power control: Harmonic sources.
Resonance, Shunt capacitors and Filters, Telephonic Interference.

UNIT – III

Reactive power coordination: Reactive power management, Transmission benefits, Reactive power dispatch and equipment impact.
Course Outcomes:
At the end of the course student will be able to
1. Describe the importance of reactive power, its generation and absorption in power system.
2. Analyze methods utilised to control the voltage or reactive power.
3. Describe the compensation techniques and effect of harmonics on reactive power in a transmission system.
4. Analyse effect of shunt capacitors, filters and telephonic interference on transmission system.
5. Describe the reactive power coordination techniques to manage the reactive power in a system.

Course Outcomes Mapping with Program Outcomes & PSO

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TEXTBOOKS:

REFERENCE BOOKS:

E-Books / MOOC / NPTEL
1. http://nptel.ac.in/courses/108101040/20

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V. MICROELECTRONICS

### ARM SYSTEM ARCHITECTURE

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**Prerequisites:** MC (18EE403)

**Course Learning Objectives:**
1. To introduce the architecture, internal functioning and assembly instructions of ARM core
2. To comprehend the functionality, interfacing, and programming of ARM core
3. To understand the floating-point representation and VFP coprocessor implementation
4. To outline details of cache architectures, AMBA bus, virtual memory management concepts with the detailed explanation on the Memory Management Unit (MMU) and Memory Protection Unit (MPU)
5. To illustrate the overview of various peripherals used with ARM core and review of big.LITTLE technology for various ARM processor

**UNIT – 1**

**ARM Introduction and Pipeline structures:** Types of computer Architectures, ISA's and ARM history. Embedded system software and hardware, stack implementation in ARM, endianness, and condition codes. Processor core vs CPU core, ARM7TDMI interface signals, memory interface, Bus cycle types, Register set, Operational modes. Instruction format, ARM Core dataf model, ARM 3 stage pipeline, ARM family attribute comparison. ARM 5 stage pipeline, Pipeline hazards, Data forwarding – a hardware solution.

8 Hours


8 Hours
UNIT - II

ARM Coprocessor interface and Vector Floating Point Processor (VFP) ARM coprocessor interface and instructions, Coprocessor instructions, data processing instruction, data transfers, register transfers. Number representations, floating point representation (IEEE 754). Flynn's taxonomy, SIMD and Vector processors, VFP and ARM interactions, An example vector operation. 7 Hours

Cache and Memory Management and Protection: Memory technologies, Need for memory hierarchy, Hierarchical memory organization, Virtual memory. Cache memory, Mapping functions, Cache design, Unified or split cache, multiple level of caches, ARM cache features, coprocessor 15 for system control. Processes, memory map, protected systems, ARM systems with MPU, Memory Protection Unit (MPU). Physical Vs virtual memory, Paging, Segmentation. MMU Advantage, virtual memory translation, Multitasking with MMU, MMU organization, Tightly Coupled Memory (TCM). 8 Hours

UNIT - III

ARM tools and peripherals ARM development environment, Arm Procedure Call Standard (APCS), example C program. Embedded software development, image structure, linker inputs and outputs, memory map, application startup. AMBA overview, typical AMAB based microcontroller, AHB bus features, APB bus transfers, APB bridge. DMA, Peripherals, Programming peripherals in ARM. big. LITTLE technology ARM ISAs, ARMv5, ARMv6, ARM v7, ARMv8. 8 Hours

Course Outcomes:
At the end of the course student will be able to
1. Describe architecture, internal functioning and assembly instructions of ARM7TDMI to comprehend basics of ARM
2. Apply ARM7 based assembly level programming skills to perceive the various coprocessors interfaced in an SoC.
3. Describe the cache design, virtual memory, memory protection concepts to visualise the implementation in a typical SoC designs
4. Describe AMBA bus architecture, various HW peripherals in SoCs to build their design aspects
5. Apply processor software tool chains for embedded software solution development

Course Outcomes Mapping with Program Outcomes & PSO

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TEXTBOOK:

REFERENCE BOOKS:
5. Manuals and Technical Documents from the ARM Inc, web site.

E Books / MOOC / NPTEL

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ANALOG AND MIXED SIGNAL LAYOUT

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Prerequisites: VLSI Circuits & Design (18EEE143)

Course Learning Objectives:
1. To understand CMOS process and its construction
2. To introduce various types of matching and mismatches
3. To illustrate floor-planning and power routing
4. To introduce sensitivity, reliability & failure mechanism
5. To comprehend ESD & types of packaging

UNIT – I

CMOS Process Overview: Silicon deposition, Photolithography, Diffusion/Ion Implantation, Metalization, Formation of devices
Device Construction: PMOS, NMOS, Drain extended MOS, Diodes, Bipolars, Resistors,
Capacitors

**Matching:** Matching and Mismatches in detail, Types of Matching and its usage, Resistor Matching, Capacitor matching

**Isolation:** Need for isolation: Noise in substrate, Guardring /Substrate connections, Integration of analog and digital blocks

UNIT – II

**Floor-planning:** Area Estimation, Module level (Understanding Hierarchy features), Block Level. Bbox concept, UNIT / Half cell concept, Pin Placement

**Power Routing:** Planning Power, Power to Devices, Star connection

**Sensitivity:** Shielding sensitive signals, routing clk /high frequency signals, DBKs

**Reliability and Failure mechanism:** Electromigration, Antenna effect, Latch up, Density.

15 Hours

UNIT – III

**ESD Care-about:** I/O cells ESD event, CDM Clamp

**Packaging:** Types of packaging, BGA, FLIP CHIP, WCSP

10 Hours

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

1. Describe the CMOS process overview to elicit device construction
2. Identify the device matching and isolation with respect to CMOS devices
3. Apply floor planning and power routing to design analog CMOS devices
4. Identify sensitivity, reliability and failure mechanism to erudite electro-migration, antenna effect, and latch up, density issues in CMOS.
5. Describe the ESD and packaging details to comprehend application of CMOS

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TEXTBOOK:
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EMBEDDED SYSTEMS

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Prerequisites: LD 18EE305

Course Learning Objectives:
1. To familiarize the concept of embedded system
2. To identify various processing elements of embedded system and their structure
3. To introduce various memory elements used in embedded systems
4. To understand various interfacing devices used with embedded systems
5. To introduce the concept of Real Time Operating Systems

UNIT – I

Introduction: Embedded systems overview-design challenge-optimizing metrics-processor technology-IC technology- design technology- automation- synthesis-verification: hardware /software co-simulation, trade-offs.

8 Hours

Processing Elements: Custom single purpose processor design-RT level custom single purpose processor design-optimizing custom single purpose processors -General purpose processor's software: architecture, operation, programmer's view and development environment - ASIPs - selecting a microprocessor - general purpose processor design.

8 Hours

UNIT – II

Memory: Introduction-memory write-ability and storage permanence, common memory types-composing memory-memory hierarchy and caches-advanced RAM.

7 Hours


9 Hours
UNIT – III

Introduction to Real-Time Operating Systems: Software architectures, Hard and soft real time systems, Basic functions of RTOS kernel, tasks and states, tasks and data, semaphores and shared data, Message Ques, Mailboxes and Pipes

8 Hours

Course Outcomes:
At the end of the course student will be able to
1. Describe the overview of embedded system to comprehend associated technologies
2. Analyse various processing element in an embedded system to develop optimum design
3. Identify the necessity of memory devices to comprehend use in embedded system
4. Describe peripherals associated with embedded system to interface various modules
5. Describe architecture of RTOS to comprehend functional capabilities of RTOS

Course Outcomes Mapping with Program Outcomes & PSO

| Program Outcomes → | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO |
|----------------------|---|---|---|---|---|---|---|---|---|----|----|----|     |
| Course Outcomes      |   |   |   |   |   |   |   |   |   |    |    |    |     |
| 18EEE241.1           | 3 |   |   |   |   |   |   |   |   |    |    |    | 1   |
| 18EEE241.2           | 2 | 3 |   |   |   |   |   |   |   |    |    |    | 1   |
| 18EEE241.3           | 2 | 3 |   |   |   |   |   |   |   |    |    |    | 1   |
| 18EEE241.4           | 2 | 3 |   |   |   |   |   |   |   |    |    |    | 1   |
| 18EEE241.5           | 2 | 3 |   |   |   |   |   |   |   |    |    |    | 2   |

1: Low 2: Medium 3: High

SEE Question Paper Pattern:
- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit – I&Unit – II and 1 full question from Unit – III.

TEXTBOOKS:
2. Embedded System Premier, David E Simon, Addison Wesley

REFERENCE BOOKS:
**DIGITAL SYSTEMS DESIGN USING HDL**

<table>
<thead>
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</table>

**Prerequisites:** LD (18EE305)

**Course Learning Objectives:**
1. To understand basic concepts of hardware description languages
2. To apply computer-aided design tools for design of complex digital logic circuits
3. To model, simulate, verify, and synthesize with hardware description languages
4. To understand the architectural features of Verilog
5. To design digital systems using VHDL and Verilog

**UNIT – I**

**Basic concepts of hardware description languages.** Hierarchy, concurrency, logic and delay modelling. Structural data-flow and behavioural styles of hardware description. Architecture of event driven simulators. Syntax and semantics of VHDL. Variable and signal types, arrays and attributes, Operators, expressions and signal assignments.

**15 Hours**

**UNIT – II**

Entities, architecture specification and configurations, Component instantiation, Concurrent and sequential constructs, Use of Procedures and functions, Examples of design using VHDL.

**7 Hours**

Syntax and semantics of Verilog, Variable types, arrays and tables, operators, expressions and signal assignments, Modules, nets and registers, Concurrent and sequential constructs, Tasks and functions

**8 Hours**

**UNIT – III**

Modelling flip-flops using VHDL, VHDL models for a multiplexer, Compilation & simulation of VHDL code, Modeling a sequential machine, variables, signals and constants, Arrays, VHDL operators, VHDL functions & procedures, Packages and libraries, VHDL model for a counter. Examples of design using Verilog, Synthesis of logic from hardware description

**9 Hours**

**Course Outcomes:**

At the end of the course student will be able to
1. Describe basic concepts of hardware description language to write program using HDL
2. Apply programming skills to design digital logic circuits using HDL
3. Describe synthesize program using HDL to design digital logic circuits
4. Describe the architectural features of Verilog to write program using HDL
5. Apply VHDL and Verilog to design digital system
Syllabus of VII & VIII Semester B.E. / Electrical & Electronics Engineering.

Course Outcomes Mapping with Program Outcomes & PSO

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1: Low 2: Medium 3: High

SEE Question Paper Pattern:
- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit - I & Unit - II and 1 full question from Unit - III.

TEXTBOOKS:

REFERENCE BOOKS:

**********************
Course Learning Objectives:
1. To study the design flow of different types of ASIC
2. To familiarize the different types of programming technologies and logic devices
3. To learn the architecture of different types of FPGA
4. To understand partitioning, floor planning, placement and routing including circuit extraction of ASIC
5. To analyse the synthesis, Simulation and testing of digital systems.
6. To understand the importance and applications of SOC.

UNIT – I

OVERVIEW OF ASIC AND PLD: Types of ASICs - Design flow - CAD tools used in ASIC Design - Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA–PAL. Gate Arrays – CPLDs and FPGAs

ASIC PHYSICAL DESIGN: System partition -partitioning - partitioning methods - interconnect delay models and measurement of delay - floor planning -placement - Routing: global routing - detailed routing - special routing - circuit extraction - DRC

UNIT – II


FPGA: Logic blocks, routing architecture, design flow technology - mapping for FPGAs, XilinxXC4000 - ALTERA's FLEX 8000/10000, ACTEL's ACT-1,2,3 and their speed performance Case studies: Altera MAX 5000 and 7000 - Altera MAX 9000 – Spartan II and Virtex II FPGAs - Apex and Cyclone FPGAs.

UNIT – III

SOC DESIGN: Design methodologies - Processes and flows - Embedded software development for SOC – Techniques for SOC testing -configurable SOC - hardware / software codesign Case studies: Digital camera, Bluetooth radio / modem, SDRAM and USB.
Course Outcomes:
At the end of the course student will be able to
1. Describe the design flow to identify different types of ASIC
2. Apply different types of programming techniques to design logic devices
3. Apply logic synthesis, simulation and testing to design digital systems
4. Analyse various manufacturer FPGA to write program for given application
5. Describe embedded software development to design applications of SOC.

Course Outcomes Mapping with Program Outcomes & PSO

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1: Low 2: Medium 3: High

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REFERENCE BOOKS:

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VI. IT & MANAGEMENT COURSES

<table>
<thead>
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<th>OBJECT ORIENTED PROGRAMMING USING C++</th>
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<td><strong>Total Hours</strong></td>
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Prerequisites: CCP (18CS111)

**Course Learning Objectives:**
1. To study the concept of Object Oriented programming and its realization in C++.
2. To discuss the concept of functions and classes.
3. To illustrate the concepts of objects constructors and destructors
4. To understand the meaning of operator overloading type conversion and inheritance.

**UNIT – I**

**Principles of Object-Oriented Programming:** Review of Procedure Oriented Programming, Basic concepts of Object Oriented Programming – Object, Class, Encapsulation, Inheritance, Polymorphism; Benefits of OOPs, Applications of OOP’s.

3 Hours

**The Basic Language C++:** A comparison of C and C++, Structure of C++ program with Class, Preprocessor directives, C++ Statements – Input/Output, Comments, Tokens, Keywords, Identifiers, Constants, Data types – string, pointer, reference, boole, enumeration, array, complex number; typedef names, type compatibility, type conversion, qualifier – const, volatile; Operators in C++, Operator Precedence; C++ expressions – New and Delete.

5 Hours

**Functions in C++:** Introduction, The main() function, Function prototype, Call by reference, Return by reference, Inline functions, Default arguments, const Arguments, Function Overloading

3 Hours

**Classes:** Introduction – declaration and definition of a Class, defining member functions, C++ program with a Class, Making an outside function Inline, Nesting of member functions, Arrays within a class, Static data members, static member functions.

4 Hours

**UNIT – II**

**Objects:** global & local objects, scope & lifetime, memory allocation for objects, dynamically allocated objects, pointers to objects, arrays of objects, function arguments with objects, returning objects; const member functions, pointer to members.

4 Hours

**Constructors and Destructors:** Introduction, Constructors, Parameterized Constructors, Multiple constructors in a class, Constructors with default arguments, Dynamic initialization of objects, Copy constructor, Constructing two-dimensional arrays, const Objects, Destructors.

4 Hours

135
**Operator Overloading and Type Conversion:** Introduction, Defining operator overloading, Overloading unary operators, Overloading binary operators, Overloading binary operators using Friends, Rules for overloading operators, overloading a comma operator, overloading the output operator, Type conversion.  

**Inheritance:** Introduction, Defining derived classes, Single inheritance, Making a private member inheritable, Multilevel inheritance, Multiple inheritance, Hierarchical inheritance, Hybrid inheritance, Virtual base classes, Abstract classes.

**UNIT – III**

**Pointer, Virtual Functions and Polymorphism:** Introduction, Pointers, Pointers to Objects, this pointer, Pointers to derived classes, type-checking pointers, pointers to members, Virtual functions, Pure virtual functions.

**Managing Console I/O and File I/O:** C++ streams, C++ stream classes, examples of formatted and unformatted I/O operations, Classes for file stream operations, Methods of Opening and Closing a File, Examples of Opening file using constructor open(), file modes (simple programming exercises).

**Course Outcomes:**

At the end of the course student will be able to

1. Describe the concept of Object-Oriented Programming and basics of C++ to compare C with C++
2. Apply functions and classes to develop simple programs
3. Apply the concept of constructors to dynamically initialize objects
4. Describe the operator overloading, type conversion and inheritance concepts to develop reliable programs.
5. Apply the concept of pointers, polymorphism and C++ stream classes to use with objects.

<table>
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1: Low 2: Medium 3: High

**SEE Question Paper Pattern:**

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TEXTBOOKS:

REFERENCE BOOKS:

E-Books / MOOC / NPTEL
2. http://nptel.ac.in/courses/106105151/

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DATA STRUCTURE

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Course Learning Objectives:
1. To understand the design, analysis of algorithms, Basic data types and trees with reference to data structure.
2. To Illustrate the basic operation on sets and representation of directed graphs.
3. To expound the sorting procedure and understand the Algorithm analysis Techniques.
4. To Comprehend the Algorithm Design Techniques.
5. To Demonstrate the use of Data structures and Algorithm for external storage.

UNIT – I

Design and Analysis of Algorithms: From problems to programs, Data Structures and Abstract Data types. 3 Hours

Basic Data Type and Trees: Data types List, Implementation of lists, stacks Queues, Mappings, Stacks and recursive procedures. Basic terminology, ADT Tree, Implementation of trees, Binary trees. 5 Hours

Basic Operation on Sets: Introduction to sets an ADT with union intersection and difference, A Bit-vector implantation sets, A linked list implementation sets, The dictionary, simple dictionary implementation, the Hash table data structures, Estimating the efficiency of functions, Implementation of the mapping ADT, Priority Queues, Implementation of priority queues. 5 Hours
Directed Graphs: Basic Definitions, Representation for directed graphs, the single source short path problems, Traversals of Directed Graphs, Directed A cyclic graphs, strong components.

UNIT – II

Sorting: The internal sorting model, simple sorting schemes, Quick sort Heapsort, Binsorting. Algorithm analysis Techniques: Efficiency of algorithms, analysis of receive programs solving Recurrence Equations, A general solution for a large class of Recurrences.

Algorithm Design Techniques: Divide and conquer algorithms, Dynamic programming, Greedy Algorithms, Back tracking, local search algorithms.

UNIT – III

Data structures and Algorithm for external storage: A model of external computation, External sorting, sorting information in files, external search Trees.

Course Outcomes:
At the end of the course student will be able to
1. Analyse algorithms to implement various basic data types and trees.
2. Apply basic operations on sets and representation of directed graphs to build trees for database queries.
3. Analyse the various sorting techniques.
4. Develop and implement various algorithm design techniques
5. Demonstrate the use of Data structures and Algorithms for external storage.

<table>
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<th>Course Outcomes Mapping with Program Outcomes &amp; PSO</th>
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1: Low 2: Medium 3: High

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TEXTBOOK:
REFERENCE BOOKS:
1. Introduction to Data structures and Algorithms with C+ by Gleen. W.Rowe, PHI Publications.1997,

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TOTAL QUALITY MANAGEMENT

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Course Learning Objectives:
This Course will enable students to
1. Understand the meaning of quality and the development of quality terminology and explain the principles of TQM.
2. Compute mean, median, mode and standard deviation and calculate area under the normal distribution and relate it to the quality concept.
3. Compute control limits for a variable chart and draw the X bar and R chart limits for attribute chart and draw p, np, c and u charts.
4. Explain the Acceptance Sampling plans and understand the concept of Design of Experiments

UNIT – I

Introduction: The Meaning of Quality and Quality Improvement; Statistical Methods for Quality Control and Improvement;
TOTAL Quality Management: Definition, Principles of TQM, Gurus of TQM, Benefits of TQM.
Modeling Process Quality: Mean, Median, Mode, Standard deviation, calculating area, Normal distribution tables, Finding the Z score, Central limit theorem, 7 QC tools.
Methods and Philosophy of Statistical Process Control: Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL).

15 Hours
UNIT – II

Control Charts for Variables: Control Charts for X-Bar and R- Charts, Type I and Type II errors, the probability of Type II error. Simple Numerical Problems.
Process Capability: The foundation of process capability, Natural Tolerance limits, \( c_p \) – process capability index, \( c_{pk} \), \( p_p \) – process performance index, summary of process measures. Numerical problems.
Control Charts for Attributes: Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non-conformities per unit. Numerical problems.

15 Hours

UNIT – III

Lot-By-Lot Acceptance Sampling for Attributes: The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, AOQL, LTPD, OC curves, Numerical problems.
Introduction to Design of Experiments: Hypothesis testing, one sample t-test, orthogonal design of experiments, two factor experimental design, numerical problems on the above topics.

9 Hours

Course Outcomes (CO):
At the end of the course the student will be able to
1. Understand the concept of quality and evolution of quality concepts over the years
2. Apply statistical concepts for solving simple quality problems.
3. Draw and analyze control charts for variables.
4. Understand the basic concepts of Acceptance Sampling and Design of experiments.
5. Draw and analyze the control chart for attributes

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- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit – I & Unit – II and 1 full question from Unit – III.
TEXTBOOKS:

REFERENCE BOOKS:
6. NPTEL course material on Design of Experiments.

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FUNDAMENTALS OF PYTHON PROGRAMMING

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J – The course instructor can implement PBL (Project Based Learning) in this course.

Course Learning Objectives:
1. To write a simple python program with emphasis on syntax and semantics
2. To write simple programs utilizing Lists, Tuples and Dictionaries.
3. To write simple program by choosing appropriate conditional operator.
4. To write simple program consisting of user defined functions.
5. To study the concept of object-oriented programming in python.

UNIT – I

Data, Expressions, Statements: Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points

15 Hours
UNIT – II

Lists, Tuples, Dictionaries: Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram

Control Flow, Functions: Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional; Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays Illustrative programs: square root, GCD, exponentiation, sum an array of numbers, linear search, binary search 15 Hours

UNIT – III

Python Object Oriented Programming: Concept of class, object and instances, Constructor, class attributes and destructors, Inheritance, overlapping and overloading operators, Adding and retrieving dynamic attributes of classes. 9 Hours

Course Outcomes:
The students should be able to:
1. Examine the Python syntax and semantics for writing effective Python Programming.
2. Write a python programme using operators, functions for a given problem statement.
3. Utilize the methods of List, Tuples and Dictionaries for write a programme for a given application.
4. Use conditional and switch case statements to write programme in Python to tackle any decision-making scenario.
5. Apply the knowledge OOPs to develop a Python programme using objects and classes

Course Outcomes Mapping with Program Outcomes & PSO

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1: Low 2: Medium 3: High

SEE Question Paper Pattern:
- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit – I&Unit – II and 1 full question from Unit – III.
TEXTBOOKS:

REFERENCE BOOKS:

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OPERATING SYSTEM

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Course Learning Objectives:
1. To introduce the operating systems concepts.
2. To explain the concepts of structure in operating systems
3. To discuss the process management and threads in operating systems
4. To understand the memory management and memory allocation in operating systems.
5. To introduce the concept of virtual memory in operating systems with example of UNIX.

UNIT – I

Introduction and Overview of Operating Systems: Operating system, Goals of an O.S, Operation of an O.S, Resource allocation and related functions, User interface related functions, Classes of operating systems, O.S and the computer system, Batch processing system, Multi programming systems, Time sharing systems, Real time operating systems, distributed operating systems.

8 Hours

Structure of the Operating Systems: Operation of an O.S, Structure of the supervisor, Configuring and installing of the supervisor, Operating system with monolithic structure,
layered design, Virtual machine operating systems, Kernel based operating systems, and Microkernel based operating systems.

**UNIT – II**


7 Hours

**Memory Management:** Memory allocation to programs, Memory allocation preliminaries, Contiguous and non-contiguous allocation to programs, Memory allocation for program controlled data, kernel memory allocation.

7 Hours

**UNIT – III**

**Virtual Memory:** Virtual memory basics, Virtual memory using paging, Demand paging, Page replacement, Page replacement policies, Memory allocation to programs, Page sharing, UNIX virtual memory. Scheduling: Fundamentals of scheduling, Long-term scheduling, Medium and short term scheduling, Real time scheduling, Process scheduling in UNIX.

9 Hours

**Course Outcomes:**
At the end of the course student will be able to
1. Summarize the overview of operating systems.
2. Describe the structure of operating systems.
3. Analyse the concept of process management, processes and threads.
4. Illustrate memory allocation and management in operating systems.
5. Analyse the concept of virtual memory and scheduling algorithms as implemented in UNIX.

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<th>Course Outcomes Mapping with Program Outcomes &amp; PSO</th>
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1: Low 2: Medium 3: High

**SEE Question Paper Pattern:**
- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit – I&II and 1 full question from Unit – III.

**TEXTBOOKS:**
REFERENCE BOOKS:

***************

OPERATIONS RESEARCH

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Prerequisites: PTNM (18EE401)

Course Learning Objectives:
1. To understand the model and obtain solution to the Linear Programming Problems.
2. To Solve the dual of LPP and compare the results of dual and primal. Also apply replacement theory for efficient operations.
3. To Solve transportation and assignment problems and to solve game theory problems
4. Build the network and crash it effectively and efficiently using PERT / CPM methods.

UNIT – I

Introduction: definition, OR models, characteristics and phases of OR. 2 Hours

Linear programming and Graphic Solution: Linear Programming: Formulation of Two variable LPP model, Graphical solution of two variables LPP, special cases in graphic solution: multiple optimal solution, infeasibility and unboundedness, simplex method: conditions and solutions to LPP using Simplex method, Big M method, Special cases in simplex method: multiple optimal, infeasibility, unboundedness, Degeneracy, sensitivity analysis. 7 Hours

Duality: Definition of the dual problem, primal to dual relationships, economic interpretation of duality. 3 Hours

Replacement Theory: Introduction, Replacement policy for equipment which deteriorates gradually, replacement of items that fail suddenly, staff replacement. 5 Hours
UNIT – II

Transportation Model: definition of transportation model, basic Feasible solution by NW Corner method, Least Cost method and MODI method, optimal solutions: stepping stone method, MODI method, the assignment model, traveling salesman problem. 8 Hours

GAME THEORY: Formulation of two - person, zero sum games, solving simple games, the Max-min min-max principles, graphical solution procedure, solving by linear programming. 7 Hours

UNIT – III

PERT & CPM TECHNIQUES: Network representation, critical path computation, construction of the time schedule, variation under probabilistic models, crashing of simple networks, PERT calculations. 7 Hours

Course Outcomes:
At the end of the course student will be able to
1. Articulate a problem statement to determine solution to the Linear Programming Problems.
2. Apply replacement theory to find optimal replacement schedule.
3. Design and solve transportation problems to develop an optimal transportation solution
4. Formulate and solve game theory problems to propose the best solution
5. Design and Solve network problems using PERT / CPM methods to develop optimal strategy.

SEE Question Paper Pattern:
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TEXTBOOKS:
REFERENCE BOOK:

E Books/ MOOC/ NPTEL
2. https://www.coursera.org/learn/wharton-operations
3. http://nptel.ac.in/courses/112106134/
4. http://nptel.ac.in/courses/112106131/
5. https://onlinecourses.nptel.ac.in/noc17_mg10/preview

INTRODUCTION TO MACHINE LEARNING WITH PYTHON

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J –The course instructor can implement PBL (Project Based Learning) in this course.

Pre-requisite:
Engineering Mathematics I, Engineering Mathematics II, 19EE301-VCTT, 19EE401-PTNM, and 19EEE251-Fundamentals of Python Programming

Course Learning Objectives:
1. To analyse the given data set.
2. To perform Linear and non-linear regression techniques using scikit learn package.
3. To perform kNN and DT techniques using scikit learn package.
4. To perform Logistic regression and SVM techniques using scikit learn package.
5. To perform clustering and Design a recommender system

UNIT – I

Regression: Introduction to Regression, Simple Linear Regression, Model Evaluation in Regression Models, Evaluation Metrics in Regression Models, Multiple Linear Regression, Gradient Descent Method, Non-Linear Regression. 15 Hours

UNIT- II

UNIT - III

Clustering: Introduction, Introduction to k-Means, Introduction to Hierarchical Clustering, DBSCAN

Recommender Systems: Introduction, Content-based Recommender Systems, Collaborative Filtering. 09 Hours

Course Outcomes:
The students should be able to:
1. identify the characteristics of datasets and compare the trivial data for various applications
2. solve regression problems using linear/non-linear regression analysis techniques for various applications.
3. Perform classification using kNN, DT for various applications
4. solve classification problem using Logistic regression and SVM for various applications
5. Perform clustering analysis and design recommender system for various applications.

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1: Low 2: Medium 3: High

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TEXTBOOKS:
VII. ELECTRIC VEHICLES TECHNOLOGIES

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**Course Learning Objectives:**
1. To understand the fundamentals of electric and hybrid electric vehicles, EV policies, standards and EV architecture.
2. To understand control strategies and design principles of series hybrid vehicle drive train.
3. To know the design principles & control strategy of parallel and series-parallel hybrid drive train.
4. To study the control principles of plug-in hybrid electric vehicles.
5. To understand fundamentals of regenerative breaking and CAN fundamentals.

**UNIT – I**

**Electric Vehicles:** Configurations of electric vehicles (EVs), Performance of EVs, Tractive Effort in Normal Driving, Energy Consumption. EV Policies & Standards

**Hybrid Electric Vehicles:** Concept of Hybrid Electric Drive Trains, Architectures of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains

**Design Principle of Series (Electrical Coupling) Hybrid Electric Drive Train:** Operation Patterns, Control Strategies, Design Principles of a Series (Electrical Coupling) Hybrid Drive Train, Design Example

**15 Hours**

**UNIT – II**

**Parallel (Mechanically Coupled) Hybrid Electric Drive Train Design:** Drive Train Configuration and Design Objectives, Control Strategies, Parametric Design of a Drive Train

**Design and Control Methodology of Series-Parallel (Torque and Speed Coupling) Hybrid Drive Train:** Drive Train Configuration, Drive Train Control Methodology, Drive Train Parameters Design


**15 Hours**

**UNIT – III**


**6 Hours**
CAN Communication: CAN Fundamentals, CAN message frames, Typical Automotive Networks,

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies.

Course Outcomes:
At the end of the course student will be able to
1. Describe the fundamentals of electric and hybrid electric vehicles to understand EV architecture.
2. Analyze control strategies to design of hybrid vehicle drive train.
3. Analyze control methodology and design of series-parallel hybrid drive train.
4. Describe the control principles of plug-in hybrid electric vehicles to predict the energy requirements.
5. Describe CAN communication and fundamentals of regenerative breaking to compare the energy management strategies.

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TEXTBOOKS:

REFERENCE BOOKS:
E-Books / MOOC:
2. Hybrid Vehicles (edX) | MOOC List (mooc-list.com)
3. NPTEL: Electrical Engineering - Introduction to Hybrid and Electric Vehicles
4. Electric Vehicles - Part 1 - Course (nptel.ac.in)
5. Electric Cars: Technology | My MOOC (my-mooc.com)

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Course Learning Objectives:
1. To study fundamentals of Hybrid Electric Vehicles (HEV) and EV powertrain component sizing.
2. To understand advanced HEV architectures and dynamics of HEV powertrain.
3. To understand plug-in hybrid electric vehicles architecture, power management and component sizing.
4. To introduce special hybrid vehicles

UNIT – I

Advanced HEV Architectures and Dynamics of HEV Powertrain - Principle of Planetary Gears, Toyota Prius and Ford Escape Hybrid Powertrain, GM Two-Mode Hybrid Transmission, Dual-Clutch Hybrid Transmissions, Hybrid Transmission Proposed by Zhang et al. Renault IVT Hybrid Transmission, Timken Two-Mode Hybrid Transmission, Tsai's Hybrid Transmission, Hybrid Transmission with Both Speed and Torque Coupling Mechanism, Toyota Highlander and Lexus Hybrid, E-Four-Wheel Drive, CAMRY Hybrid, Chevy Volt Powertrain, Dynamics of Planetary-Based Transmissions

15 Hours

UNIT – II

Plug-in Hybrid Electric Vehicles - Introduction to PHEVs, PHEV Architectures, Equivalent Electric Range of Blended PHEVs, Fuel Economy of PHEVs, Power Management of PHEVs, PHEV Design and Component Sizing, Component Sizing of EREVs, Component Sizing of Blended PHEVs, HEV to PHEV Conversions, Other Topics on PHEVs, Vehicle-to-Grid Technology

15 Hours

UNIT – III

Special Hybrid Vehicles - Hydraulic Hybrid Vehicles, Off-road HEVs, Diesel HEVs, Electric or Hybrid Ships, Aircraft, Locomotives, Other Industrial Utility Application Vehicles, HEV Applications for Military Vehicles

9 Hours
**Course Outcomes:**
At the end of the course student will be able to
1. Describe the fundamentals of HEV and planetary gears to estimate EV powertrain component sizing
2. Analyze advanced HEV architectures and speed - torque coupling mechanism to understand hybrid transmissions of different manufacturers.
3. Describe the architecture of plug-in hybrid electric vehicles to understand power management.
4. Analyze the component sizing and concept of vehicle-grid technology.
5. Compare and contrast various special hybrid vehicles.

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1: Low 2: Medium 3: High

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**TEXTBOOK:**

**REFERENCE BOOKS:**

**E-Books / MOOC:**
2. Hybrid Vehicles (edX) | MOOC List (mooc-list.com)
3. NPTEL: Electrical Engineering - Introduction to Hybrid and Electric Vehicles

***************
POWER ELECTRONICS & DRIVES FOR ELECTRIC VEHICLES

Course Code 18EEE163  CIE Marks 50
Teaching Hours/Week (L:T:P) 3:0:0  SEE Marks 50
Total Hours 39  Credits 03

Course Learning Objectives:
1. To explain the principles of power electronics converters used in HEVs
2. To understand the concept of battery chargers and thermal management of HEV power converters.
3. To study various electric drives used in EVs and their control
4. To analyze design and modeling of traction motors.
5. To introduce vehicular power control strategy & energy management.

UNIT – I
Power Electronics in HEVs
Introduction, Principle of Power Electronics, Rectifiers Used in HEVs, Buck Converter Used in HEVs, Non-isolated Bidirectional DC–DC Converter, Voltage Source Inverter, Current Source Inverter, Isolated Bidirectional DC–DC Converter, DC–DC Converters Applied in Hybrid Electric Vehicle Systems, PWM Rectifier in HEVs, EV and PHEV Battery Chargers, Emerging Power Electronics Devices, Circuit Packaging, Thermal Management of HEV Power Electronics

15 Hours

UNIT – II
Electric Drives and Control in HEVs
Introduction, Induction Motor Drives and Control, Permanent Magnet Motor Drives, Switched Reluctance Motors, Doubly Salient Permanent Magnet Machines, BLDC Motor and Control, Design and Sizing of Traction Motors, Thermal Analysis and Modeling of Traction Motors

15 Hours

UNIT – III
Vehicular Power Control Strategy and Energy Management
A Generic Framework, Definition, and Needs, Methodology to Implement, Benefits of Energy Management, Modeling and Simulation of HEV Power Electronics

9 Hours

Course Outcomes:
At the end of the course student will be able to
1. Analyze various power electronics converters used in HEVs.
2. Describe various converters for EV battery charging, emerging power electronics devices and thermal management.
3. Analyze the operation and control of various electric drives used in HEVs.
4. Select, design, model and perform thermal analysis of traction motors.
5. Analyze vehicular power control strategy to model & simulate HEV power converters.
Syllabus of VII & VIII Semester B.E. / Electrical & Electronics Engineering.

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**TEXTBOOKS:**

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154
Course Learning Objectives:
1. To understand working of various energy storage devices
2. To introduce the concept of fuel cells
3. To analyze fuel cell hybrid electric drive train design
4. To compare various energy storage systems and modeling
5. To discuss battery charge control and management

UNIT – I


9 Hours

UNIT – II


16 Hours

UNIT – III


14 Hours

Course Outcomes:
At the end of the course student will be able to
1. Describe various energy storage technologies used in EVs
2. Analyze operating principle and characteristics of fuel cells to be used in EVs
3. Analyze and design various hybrid electric drive train configurations
4. Compare and model various energy storage devices used in HEV
5. Analyze battery charge control and charge management of storage devices.
Course Outcomes Mapping with Program Outcomes & PSO

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>1</th>
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</table>

1: Low 2: Medium 3: High

SEE Question Paper Pattern:
• There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 1 full question from Unit – I & two full questions each from Unit – II and Unit – III.

TEXTBOOKS:

***************

ELECTRIC VEHICLE BATTERY CHARGING METHODS AND TOPOLOGIES

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Course Learning Objectives:
1. To understand fundamentals and selection of storage devices for electric vehicles
2. To study the electric vehicle battery parameters and analyze effect on battery efficiency
3. To explain electric vehicle battery charging technologies
4. To understand electric vehicle battery discharging behavior.
5. To understand electric vehicle battery performance and thermal management.

UNIT – I


UNIT – II

ELECTRIC VEHICLE BATTERY CHARGING: Charging a Single VRLA Battery, Charge Completion of a Single VRLA Battery, Temperature Compensation During Battery Charging, Charging NiMH Batteries, Rate of Charge Effect on Charge Acceptance Efficiency of Traction, Battery Packs, Environmental Influences on Charging, Charging Methods for NiMH Batteries, Charging Technology, Battery Pack Corrective Actions


ELECTRIC VEHICLE BATTERY DISCHARGING: Definition of VRLA Battery Capacity, Definition of NiMH Battery Capacity, Discharge Capacity Behavior, Discharge Characteristics of Li-ion Battery, Discharge of an Electric Vehicle Battery Pack, Cold-Weather Impact on Electric Vehicle Battery Discharge

UNIT – III


Course Outcomes:

At the end of the course student will be able to
  1. Explore concepts and selection of storage devices for electric vehicles.
  2. Analyze the electric vehicle battery parameters and battery efficiency.
  3. Explore electric vehicle battery charging technologies
  4. Analyze electric vehicle battery discharging behavior.
  5. Analyze electric vehicle battery performance and thermal management.
Syllabus of VII & VIII Semester B.E. / Electrical & Electronics Engineering.

Course Outcomes Mapping with Program Outcomes & PSO

<table>
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<tr>
<th>Program Outcomes</th>
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1: Low 2: Medium 3: High

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TEXTBOOK:
1. Electric vehicle battery systems by Sandeep Dhameja, Newnes Publishing, 2002

MODELING AND CONTROL OF HYBRID ELECTRIC VEHICLES

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<td>Total Hours</td>
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<td>Credits</td>
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Course Learning Objectives:
1. To model hybrid electric vehicle system components
2. To model energy storage system
3. To study hybrid electric vehicle vibration, noise & control
4. To analyze the performance of HEVs

UNIT – I


15 Hours

UNIT – II

Modeling and Parameter Estimation of Energy Storage System - Electrical equivalent model of energy storage system, Methods of Determining the State of Charge, Estimation
of Battery Power Availability, Battery Life Prediction, Cell Balancing, Estimation of Cell Core Temperature, Battery System Efficiency 8 Hours

Hybrid Electric Vehicle Vibration, Noise, and Control - Basics of Noise and Vibration, General Description of Noise, Vibration, and Control in Hybrid Electric Vehicles. 7 Hours

UNIT – III


Course Outcomes:

At the end of the course student will be able to
1. Analyze and model mechanical components of hybrid electric vehicle system.
2. Analyze and model electrical components of hybrid electric vehicle system.
3. Model and estimate parameter of energy storage system.
4. Analyze and control hybrid electric vehicle vibration & noise.
5. Analyze performance of HEV and HEV simulate system.

**Course Outcomes Mapping with Program Outcomes & PSO**

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TEXTBOOK:

***************
## OPEN ELECTIVES FOR 2021-2022

### OPEN ELECTIVE - I (VII Semester)

<table>
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<th>Sl. No.</th>
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<tr>
<td>1.</td>
<td>18MA8X02</td>
<td>Linear Algebra (for all except CS, IS &amp; EC)</td>
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<tr>
<td>2.</td>
<td>18HU8X03</td>
<td>Intellectual property rights (for all)</td>
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<tr>
<td>3.</td>
<td>18CV8X07</td>
<td>Environment Impact Assessment (for all except Civil)</td>
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<td>4.</td>
<td>18ME8X08</td>
<td>Industrial Pollution Control (for all except Mechanical)</td>
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<td>5.</td>
<td>18EE8X10</td>
<td>Non-Conventional Energy Systems (for all except EE &amp; Mech.)</td>
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<td>18EC8X18</td>
<td>Consumer Electronics (for all except EC)</td>
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<td>7.</td>
<td>18HU8X24</td>
<td>Professional and Cognitive Communique (for all)</td>
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<td>8.</td>
<td>18BT8X42</td>
<td>Solid Waste Management (for all except BT &amp; Civil)</td>
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<td>18ME8X63</td>
<td>Innovation &amp; Entrepreneurship (for all)</td>
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<td>Introduction to Yoga (for all)</td>
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<td>Philosophy (for all)</td>
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<td>Overview of Indian Culture and Arts (for all)</td>
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<td>Principles to Physical Education (for all)</td>
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<td>Introduction to Japanese language (for all)</td>
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<td>Web Technologies (for all except CS &amp; IS)</td>
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<td>Programming in Java (for all except EC,CS &amp; IS)</td>
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<td>Data Structures &amp; Algorithms (for all except EC,CS &amp; IS)</td>
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<td>Electric Vehicle Technology (for all except EE)</td>
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<td>22.</td>
<td>18ME8X28</td>
<td>Operations Management and Entrepreneurship (for all except Mechanical)</td>
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**Total**
# OPEN ELECTIVE - II (VIII Semester)

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**Total**
This Course will enable students to
1. Explain subgraphs, bipartite graphs, isomorphic graphs etc..
2. Apply the concept of trees and its properties.
3. Distinguish between planar and nonplanar graphs and apply their properties to solve problems.
4. Represent a graph in terms of adjacency matrix, incidence matrix etc. and vice-versa.
5. Find the shortest path between two vertices in a graph.

UNIT – I
Introduction to graphs, digraphs, subgraphs-spanning and induced graphs, paths, cycles, connectivity, cut points, bridges and blocks. Trees. 
10 Hours

UNIT - II
Eulerian graphs, characterizations, Hamiltonian graphs.
Planar graphs, outer planar graphs, Euler’s polyhedron formula. Colorability: chromatic number, five colour theorem, four colour conjecture and chromatic polynomial.
15 Hours

UNIT – III
Representations of graphs: adjacency matrix, incidence matrix, circuit matrix, cutset matrix. Shortest paths in weighted graphs, Dijkstra’s algorithm to find shortest paths.
Spanning trees: Algorithms to find a spanning tree, minimal spanning tree-Kruskal’s & Prim’s algorithm.
14 Hours

Course Outcomes:
At the end of the course the student will be able to
1. Distinguish between bipartite and complete bipartite graphs, identify whether two graphs are isomorphic, find subgraphs of a graph etc.
2. Distinguish between Eulerian and Hamiltonian graphs.
3. Identify whether a graph is planar and to find the chromatic polynomial of a graph.
4. Apply algorithmic methods to find the shortest path between two given vertices.
5. Use a suitable algorithm to find a minimal spanning tree.

Mapping of POs & COs:

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L : Low   M: Medium   H : High
TEXTBOOKS:
2. Narsing Deo, “Graph Theory with applications to Engg. and Comp. Sciences”, PHI.

REFERENCE BOOK:
1. D. B. West, “Introduction to Graph Theory”, PHI.

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<td>Credits</td>
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Course Learning Objectives:

This Course will enable students to
1. Develop a thorough knowledge about the system of linear equations and obtaining their solutions
2. Interpret vectors in two and three-dimensional spaces both algebraically and geometrically.
3. Determine the kernel, range, rank, and nullity of a linear transformation and apply them suitably in their field of study
4. Evaluate the eigenvalues and their corresponding eigenspaces and appraise its importance in various fields.
5. Make use of Gram-Schmidt process to produce an orthonormal basis.

UNIT – I

LINEAR EQUATIONS
System of linear equations and its solution sets, elementary row operations and echelon forms, matrix operations, invertible matrices and LU-factorization.

8 Hours

UNIT - II

VECTOR SPACES
Vector spaces, subspaces, bases and dimension, coordinates, summary of row-equivalence and computations concerning subspaces.
LINEAR TRANSFORMATIONS
Linear transformations, algebra of linear transformations, isomorphism, representation of transformations by matrices, linear functions and transpose of a linear transformation. Determinants and elementary properties.

15 Hours

UNIT - III

CANONICAL FORMS
Characteristic values, similarity of matrices, Cayley Hamilton theorem, annihilating polynomials, invariant subspaces, diagonalization of symmetric matrices, iterative estimates of characteristic values.
INNER PRODUCT SPACES
Inner products, inner product spaces, orthogonal sets and projections, Gram-Schmidt process, QR-factorization, least-squares problems, symmetric and unitary operators.

16 Hours
Course Outcomes:
At the end of the course the student will be able to
1. Test for consistency of system of linear equations and compute the solution by different methods.
2. Interpret vectors in two and three-dimensional spaces both algebraically and geometrically.
3. Analyze the concept of a linear transformation as a mapping from one vector space to another and be able to calculate its matrix representation with respect to standard and nonstandard bases.
4. Evaluate the eigenvalues and their corresponding eigenspaces and explain its importance in various fields.
5. Make use of Gram-Schmidt process to produce an orthonormal basis and also able to use least square approximation method to obtain the solution of ill conditioned system.

Mapping of POs & COs:

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<th>POs</th>
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L : Low  M: Medium  H : High

TEXTBOOKS:

REFERENCE BOOKS:

INTELLECTUAL PROPERTY RIGHTS

<table>
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Course Learning Objectives:
Students should be able to:
1. Understand the creativity component in intellectual property, different types of legal protection of intellectual properties and other basic concepts of Intellectual property.
2. Analyze different types of protection for inventions, different types of agreements and treaties for Intellectual properties with an ability to examine patent types, specifications and patent search and database for 'prior art'.
3. Understand the basic procedure of drafting claims, apply for patents, other legal forms of intellectual property rights and also to examine the protocol involved in protection of inventions like patents.
UNIT – I

Introduction to Intellectual Property
Invention and Creativity - Intellectual Property (IP) – Importance, Jurisprudential definition and concept of property, rights, duties and their correlation; History and evaluation of IPR – like Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications. 8 Hours

Agreements and Treaties

UNIT – II

Basics of Patents and Concept of Prior Art
Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in the context of “prior art”; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, WIPO, IPO, etc.) 8 Hours

Patent filing procedures
National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Structure of Patent document, Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies 8 Hours

UNIT – III

Case Studies:
Patents (Basmati rice, Turmeric, Neem, etc.) non-biological cases – (i) TVS V/S HERO, (ii) Samsung V/S Nokia – Copyright and related rights – Trade Marks – Trade secrets - Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition; Technology transfer and license agreements (US anti-HIV drug license to Africa) 7 Hours

Course Outcomes:
At the end of the course the students will be able to have
1. General understanding of the Intellectual Property Rights and an awareness of different forms of intellectual property rights, national and international IPR related legislations.
2. Knowledge of National and International Trade Agreements and Agencies functioning in relation to intellectual property rights with general understanding of patenting procedures and licensing.
3. General understanding about the provisions, privileges and limitations of intellectual property right holders with an understanding of the legal aspects (civil or criminal) of the use of intellectual property rights.
Mapping of POs & COs:

<table>
<thead>
<tr>
<th>COs/POs</th>
<th>a</th>
<th>b</th>
<th>c</th>
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</table>

L : Low  M: Medium  H : High

REFERENCE BOOKS:
5. Intellectual Property Today: Volume 8, No. 5, May 2001,

Important Links:
1. http://www.w3.org/IPR/
4. www.patentoffice.nic.in
5. www.iprlawindia.org/

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NANOTECHNOLOGY

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<tr>
<td>Total Hours</td>
<td>39</td>
<td>Credits</td>
<td>03</td>
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</table>

**Prerequisites:** Chemistry, Physics
**Corequisites:** Nil
Course Learning Objectives:
The objective of this course is
- To learn fundamental concepts of nanoscience and nanotechnology
- To appreciate the application of nanoscience to various fields of engineering.

UNIT – I

INTRODUCTION
Introduction to nanoscience, A Brief History of the Super Small, Definition of nanotechnology, Bottom-Up versus Top-Down; Discussions on nanofabrication, Nanolithography(Dip pen, photo, X-ray, Electron beam, nanosphere lithography), Structure-property relationships in materials, Fabrication of Hard Materials.

NANOMATERIAL AND NANO TOOLS
Zero dimensional: Nano particle, 1-D: Nano wires, nano rods, 2-D: Thin films, Special nanomaterials: Buckyballs (Fullerenes), Nanotubes, nanowire, Dendrimers, Nanoshells, magnetic nanoparticle, Quantum Dot (Nanocrystals), self-assembled monolayers, Scanning probe microscopy (Scanning tunneling microscopy, Atomic force microscopy). Characterization of nanomaterials: Physical, chemical and structural. Applications of nanomaterial 15 Hours

UNIT – II

MICROFLUIDICS
Microflows (Laminar flow), Hagen-Pouiselle equation, micromixing, microvalves & micropumps, Need for the microfluidics, Fabrication of Soft Materials, application of microfluidics. Microfluidics and their applications to lab on chip.

MEMS
Introduction and Overview, Design of MEMS, Sensors, Material aspect of MEMS, Electromagnetic Transducers, Mechanical Transducers, Chemical Transducers, Optical Transducers – Applications of optical and chemical transducers. Recent Developments in MEMS and Nano chips. Application of MEMS. 15 Hours

UNIT - III

APPLICATIONS
Sporting goods equipment, Apparel industry, Cosmetics, Appliances, Automobile/vehicle industry, Paint and Other water resistance coatings, Removing windshield fog, Medical bandages, Organic light-emitting displays, Medical applications, Food and Agriculture. Nanotechnology for data storage. Risk assessment, management, ethical aspects. 9 Hours

Course Outcomes:
At the end of this course student will be able to
1. Understand the terminologies of nanotechnology, nanofabrication and structure-property relationship of materials.
2. Learn and understand synthesis of nanomaterials, structures and their methods of characterization.
3. Understand the concepts of microfluidics and its applications
4. Apply nanotechnology concepts in the field of MEMS
5. Apply nanotechnology concepts in various engineering discipline and assess the risk involved in nanotechnology products
Mapping of POs & COs:

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**TEXTBOOKS:**


**REFERENCE BOOKS:**


**SEE QUESTION PAPER PATTERN:**

<table>
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**ENVIRONMENTAL IMPACT ASSESSMENT**

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<td>Total Hours</td>
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**Course Learning Objectives:**

This Course will enable students to

1. Identify the need to assess and evaluate the impact of projects on environment.
2. Explain major principles of environmental impact assessment.
3. Understand the different steps within environmental impact assessment.
4. Appreciate the importance of EIA for sustainable development and a healthy environment.

**UNIT – I**

Evolution of EIA: Concepts of EIA, EIA methodologies (Adhoc, Network Analysis, Checklists, Map overlays, Matrix method), Screening and scoping, Rapid EIA and
Comprehensive EIA, General Framework for Environmental Impact Assessment, EIA Specialized areas like environmental health impact assessment, Environmental risk analysis.  

16 Hours

UNIT - II

Baseline data study, Prediction, and assessment of impacts on physical, biological, and socio-economic environment, Legislative and environmental clearance procedures in India, Public participation, Resettlement, and rehabilitation.  

10 Hours

UNIT – III

Fault free analysis, Consequence Analysis, Introduction to Environmental Management Systems, Environmental management plan-Post project monitoring Environmental Audit: Cost Benefit Analysis, Life cycle Assessment. Case studies on project, regional and sectoral EIA.  

13 Hours

Course Outcomes:
At the end of the course the student will be able to
1. Understand phenomena of impacts and know the impact quantification of various projects in the environment.
2. Liaise with and list the importance of stakeholders in the EIA process.
3. Know the role of public in EIA studies.
4. Overview and assess risks posing threats to the environment.
5. Assess different case studies/examples of EIA in practice.

Course Articulation Matrix :

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<th>CO</th>
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Note:- 1:Low  2:Medium  3: High

TEXTBOOKS:

ADDITIONAL REFERENCE MATERIALS
INDUSTRIAL POLLUTION CONTROL

Course Code | 18ME8X08       | CIE Marks | 50
Teaching Hours/Week (L:T:P) | 3:0:0       | SEE Marks | 50
Total Hours | 39           | Credits   | 03

Course Learning Objectives: This Course will enable students to,
1. Know the Consequences of pollution, relationship between man and environment over the last few decades, necessity of modern awareness on pollution and how carbon audit can help in developing a carbon strategy.
2. Identify the Importance of Meteorology in pollution control and global warming, various types of plume dispersions and its effect; analyze various levels of plume height for different pollutants.
3. Distinguish Particulates and fly ash separation techniques such as cyclone separator, electrostatic precipitator efficiency calculations etc.
4. Illustrate Formation, measurement and control techniques for Smoke and gaseous pollutants.
5. Summarize the Effects of water, soil, plastics and odor pollution their control techniques, Different Pollution Control Acts, Legal aspects of pollution control and how these acts can help in bringing down the pollution rate.

UNIT - I

Introduction to Pollution
Man and the environment, types of pollution and its consequences, Changing environmental management concept, sustainable industrial growth, carbon audit, Ill effects of various pollutants, permissible concentration levels & AQI.

Meteorology
Meteorology, Wind rose, Lapse rate, plume dispersion studies & Numerical problems

UNIT - II

Separation techniques
Different types of Particulates, Need for Separation techniques, Sources of Particulates Matter Fly Ash Electrostatic precipitator (Problems) Theory of settling processes (Design Problems), Bag House fabric filter Cyclone separator Spray Tower Scrubbers & Venturi Scrubber

Smoke and gaseous pollutants
Smoke- White, blue and black smoke, Sources of smoke, T,T,T-O Principle of smoke Measurement of stack smoke intensity using Ringlemann Chart and Smokescope & Bosch Smoke meter, Domestic and Industrial Incinerators-Design factors, Pollutant gaseous So2, Co, UBHC, Nox their ill effects and & control methods..
UNIT – III

Water, soil, noise, and odor pollution, their control methods, problems associated with nuclear reactors, Legal aspects of pollution control in India, brief details of Euro and BS standards.

9 Hours

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

<table>
<thead>
<tr>
<th>CO 1</th>
<th>Identify the various types of pollutants and distinguish between them with regards to Particulate matters and AQI.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 2</td>
<td>Outline the instruments for Meteorological measurements, distinguish types of plume dispersions and its effect; analyze the concentration of various gaseous pollutants from T-Z diagrams.</td>
</tr>
<tr>
<td>CO 3</td>
<td>Explain the Particulates and fly ash separation techniques, compare and Interpret their efficiency.</td>
</tr>
<tr>
<td>CO 4</td>
<td>Illustrate Formation, measurement and control techniques for Smoke and gaseous pollutants.</td>
</tr>
<tr>
<td>CO 5</td>
<td>Identify Effects of water, soil, plastics and odor pollution on environmental Pollution and explain the Legal aspects of pollution control.</td>
</tr>
</tbody>
</table>

TEXTBOOKS:
1. “Environmental Pollution Control Engineering, Wiley Eastern Ltd.,
3. “Environmental Pollution Control Engineering, C. S RAO New Age Int.

REFERENCE BOOKS:
2. “Air Pollution control”, W. L. Faith, John Wiley

MOOC/NPTEL Resources:
1. http://nptel.ac.in/courses/105106119/36

Course Articulation Matrix

<table>
<thead>
<tr>
<th>Course Outcomes (CO)</th>
<th>Program Outcomes (PO)</th>
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</table>

1: Low    2: Medium    3: High

Scheme of SEE Question Paper

There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

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171
NON-CONVENTIONAL ENERGY SYSTEMS

<table>
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<td>SEE Marks</td>
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</tr>
<tr>
<td>Total Hours</td>
<td>39</td>
<td>Credits</td>
<td>03</td>
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</tbody>
</table>

Eligible Students: For all engineering stream except E&E and Mechanical Engineering

Prerequisite:
Students are expected to have a fundamental knowledge of Basic Electrical Engineering (18EE104)

Course Learning Objectives (CLO):
1. To illustrate the principle of extraction of energy from conventional, nonconventional sources.
2. To demonstrate the working principle and applications of solar based thermal, electrical and PV systems.
3. To justify the usage of energy storage techniques and understand the process of design and implement wind based energy conversion systems.
4. To understand the process of design and implement biomass based energy conversion systems.

UNIT – I


3 Hours


5 Hours


4 Hours

Solar PV Systems- stand-alone and grid connected, Applications- Street lighting, Domestic lighting and Solar Water pumping systems.

4 Hours

UNIT – II


4 Hours

Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS. 
Wind site selection consideration, Advantages and Disadvantages of WECS. 

4 Hours

**Biomass Energy:** Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, Factors affecting biogas generation, types of biogas plants- KVIC and Janata model, Biomass program in India

6 Hours

**UNIT – III**

**Energy From Ocean:** Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plant, Estimation of Energy – Single basin and Double basin type TPP (no derivations, Simple numerical problems), Advantages and Limitation of TPP. Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle), Hybrid cycle, Site-selection criteria, Biofouling, Advantages & Limitation of OTEC

5 Hours

**Emerging Technologies:** Fuel Cell, Small Hydro Resources, Hydrogen Energy and Wave Energy (Principle of Energy generation using block diagrams, advantages and limitations)

4 Hours

**Course Outcomes:**
At the end of the course student will be able to
1. Describe non-conventional energy sources and solar radiation geometry to estimate and measure solar radiation.
2. Apply the principle of solar radiation into heat to understand the operation of solar thermal and solar electric systems.
3. Describe energy storage methods and wind–energy conversion systems to understand the factors influencing power generation.
4. Review the biomass conversion technologies to design biomass-based energy systems.
5. Describe tidal, ocean thermal and fuel cell energy conversion systems to understand emerging non-conventional energy technologies.

<table>
<thead>
<tr>
<th>Course Outcomes: Mapping with Program Outcomes</th>
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<tbody>
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</table>

1: Low 2: Medium 3: High

**SEE Question Paper Pattern:**

- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit - I&Unit – II and 1 full question from Unit – III.
TEXTBOOK:

REFERENCE BOOKS:

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ESSENTIALS OF INFORMATION TECHNOLOGY

<table>
<thead>
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Course Learning Objectives:

This Course will enable students to
1. Outline the fundamentals of python programming.
2. Implement the object oriented concepts using python programming.
3. Describe the basic concepts of Relational Database Management System.
4. Apply the normalization to the Databases and develop databases using SQL and PL/SQL Queries.
5. Develop the data base connectivity in integration with python and perform various Database operations.

UNIT - I


OBJECT ORIENTED PROGRAMMING USING PYTHON Introduction to Object Oriented Paradigm: Abstraction and Entity, Encapsulation and Data hiding, Class and Object, Unified Modelling Language (UML), Object Oriented Approach, Class Variables, Class methods and Static Methods, Documentation, Inheritance & Polymorphism: UML: is-a relationship (Generalization), Types of Inheritance, Multiple Inheritance, Polymorphism, Benefits of OOP, Memory Management in Python, Relationships: has-a relationship: Aggregation & Composition, uses-a relationship; File handling, Exception Handling, Raising Exceptions

15 Hours
UNIT - II

RELATIONAL DATABASE MANAGEMENT SYSTEM  Data and Need for DBMS: Data – Is it important, What is Data, Do we need to store data, How to Store / Handle Data, What is DBMS and its Models, Functional Needs of DBMS, Data perspectives in DBMS; Relational Model and Keys: What is RDBMS, Data representation in RDBMS, Keys in RDBMS; Database Development Life Cycle; Data Requirements; Logical Database Design: Different Approaches in Logical Design, ER Modeling, ER Notations, Steps in ER Modeling; Physical Database Design: Converting ER Model to Relational Schema ;Normalization: Functional Dependency, First Normal Form: 1NF, Second Normal Form: 2NF, Third Normal Form: 3NF, Normalization Guidelines;

Implementation with SQL: What is SQL, Data types and Operators in SQL, SQL Statements: SQL - Built-in Functions; SQL - Group by and Having Clauses Joins: Inner Join, Outer Join, Self-Join, Sub Queries: Independent Sub queries, Correlated Sub queries, Index, Views, Transactions, PL/SQL

15 Hours

UNIT - III

PYTHON DATABASE INTEGRATION Why Database Programming, Python Database Integration – Pre-requisites and Installation, SELECT Operation: Retrieve Data from Database, Attributes of Cursor object, Bind variables, CREATE and INSERT Operation: Creating a table, Insert Operation, Inserting Multiple Records, UPDATE Operation, DELETE Operation, Exception Handling.

9 Hours

Course Outcomes: At the end of the course the student will be able to:
1. Explain the basic program constructs of Python Programming.
2. Design and apply the object oriented programming construct using Python to build the real world application.
3. Summarize the concepts related to Relational Database Management System.
4. Design and develop databases from the real world by applying the concepts of Normalization using SQL and PL/SQL.
5. Perform the various Database operations by connecting Python with Database.

TEXTBOOKS:

REFERENCE BOOKS:

**********

175
CONSUMER ELECTRONICS

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<td>Credits</td>
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</tbody>
</table>

Course Learning Objectives:

This course will enable the students to

1. Learn and design operating principles of "real world" electronic devices
2. Study broader view of key principles of electronic device’s operation and presents a block circuit diagram.
3. Learn to integrate the many different aspects of emerging technologies and able to build unique mix of skills required for careers.

UNIT – I

Sound: Properties of sound and its propagation, Transducers (Micro Phone, Loud Speakers), enclosures, mono-stereo, Amplifiers, Multiplexers, mixers, Synthesizers.
Vision: B/W TV, CTV concepts, B/W & Color Cameras, Displays.

UNIT – II

Recording and Playback: Optical discs; recording and playback, audio and video systems, Theatre Sound, Studios, Editing.
Communications and Broadcasting: Switching Systems, Land lines, Modulation, Carrier, Fiber optics, Radio and TV broadcasting
Data Services: Data services, mobiles, terrestrial & Satellite Systems, GPS, Computers, internet Services.

UNIT – III

Utilities: Fax, Xerox, Calculators, Microwave ovens, Washing Machines, A/C & refrigeration, Dishwashers, ATMS, Set -Top boxes, Auto Electronics, Industrial Electronics, Robotics, Electronics in health / Medicine, nano-technologies.

Course Outcomes:

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

1. Recall basics of sound.
2. Recall basics of television and camera.
3. Explain basic working of Recording, storage devices,
4. Explain basics of communication and broadcasting.
5. Recall basic working of commonly used electronic gadgets

TEXTBOOKS:


REFERENCE BOOK:

Scheme of SEE Question Paper
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

**PROFESSIONAL & COGNITIVE COMMUNIQUÉ**

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<td>Credits</td>
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</table>

UNIT – I

Commonsense and Emotional Intelligence
Commonsense, Commonsensical Consensus, Critical thinking, Unsettling commonsensical Consensus, Role of language in Commonsense and Critical Thinking; Nature & Functions of Emotional Intelligence, Emotions, Intelligence and Creativity, Growth of Emotional Intelligence

Etiquettes & Workplace
Etiquette, Workplace Etiquettes, Workplace Readiness Skills, Significance of Cross Cultural Understanding; Cultural Sensitivity, Impact of Social Media in Workplace 15 Hours

UNIT - II

Social Networking Sites and its Impacts
Emergence of Social Media, Impact on Gender and Self Representation, Regulatory and Liberatory aspects of Social Media, Offline Norms & Online Behaviour

Gender and Body
Gender & Sex, Genderization, Homogeneity and Heterosexuality, Gender Expressions, Gender Schooling, Representations of Body, Objectification, Gender Perspectives of Body, Different Ways of Seeing the Body, Discipline & Coercion, ISA & RSA 15 Hours

UNIT - III

Writing
Types of Writing, Note Taking Methods, Plagiarism

Reading
Styles of Reading, Types of Reading, Scanning, Skimming 9 Hours

<table>
<thead>
<tr>
<th>Course Outcomes Mapping with Program Outcomes</th>
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<tbody>
<tr>
<td>Program Outcomes</td>
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<tr>
<td>↓Course Outcomes</td>
</tr>
<tr>
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<tr>
<td>CO4</td>
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<tr>
<td>CO5</td>
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</table>
REFERENCE BOOKS:

Course Outcomes:
By the end of the Course, students will be able to
- Problematize Commonsense & Apply Critical thinking skills
- Comprehend etiquettes and manners in different situations
- Be gender sensitive in both offline and online behavior
- Exhibit better comprehension of the social implications of human body
- Understand the importance of reading and writing skills

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OPERATIONS MANAGEMENT & ENTREPRENEURSHIP

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<thead>
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Course Learning Objectives: This Course will enable students to,
1. Define production/operations management, Classify Production and service system and different type of production systems, Understand the importance of CRM and ERP
2. Appreciate the importance of Quality tools and methods in operations management
3. Analyze the data draw variable process control charts and determine process capability; Understand salient issues concerning reliability
4. Understand the issues related to entrepreneurship, characteristics of an entrepreneur and different studies carried out during project appraisal.
5. Identify and differentiate the different national and state level funding agencies.

UNIT - I

Introduction to Production/ Operations Management: Concept of production, Classification of production systems, Production Management, Concept of operations, Distinction between Manufacturing Operations and Service Operations, Objectives of Operations Management (Customer Service and Resource utilization/ Competitive advantage through Quality-Delivery-Cost), Scope of Operations Management. Introduction
<table>
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<tr>
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<tr>
<td>CO 5</td>
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</tbody>
</table>
TEXTBOOKS:


REFERENCE BOOKS:


MOOC/NPTEL Resources:

1. http://nptel.ac.in/courses/110105067/
2. https://www.edx.org/course/operations-management-iimbx-om101-1x

Course Articulation Matrix

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1: Low  2: Medium  3: High

Scheme of SEE Question Paper

There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

***********
HUMAN RESOURCE MANAGEMENT

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Course Learning Objectives:

This Course will enable students to

1) To develop a meaningful understanding of HRM theory, functions and practices.
2) To understand concepts and skills recruitment.
3) To understand the concepts of training and development.
4) To deal with employees’ grievances, safety and health types of organizations.
5) To understand the concepts of e-HRM.

UNIT - I

Human Resource Management & HRP:
Introduction, meaning, nature, scope of HRM. Major functions of HRM, Personnel Management vs Human Resource Management, job design, job evaluation, job analysis, job specification, job enlargement, job enrichment. Role of HR Manager. HR Planning. Process HRP.

8 Hours

Recruitment: Definition, Sources and Methods of Recruitment
Placement: Meaning, Induction/Orientation, Internal Mobility, Transfer, Promotion, Demotion and Employee Separation. Performance Appraisal methods

8 Hours

UNIT - II

Training and development: Training v/s development, stages in training, Training Methods, Executive Development, Methods and Development of Management Development, Career and Succession Planning.
Compensation: Employee remuneration, rewards, Wage and Salary Administration, Bonus, fringe benefits.
Internal Mobility, External Mobility, Trade union Act (Amendment) 2001.

7 Hours

Employee Grievances: Employee Grievance procedure. Discipline procedure
Collective bargaining; Characteristics, Necessity, Forms
Safety & Health; Industrial accidents, Safety
Quality circle; Meaning, Structure

8 Hours

UNIT - III

IHIRM. Managing IHIRM. e-HR Activities, Global recruitment, selection, expatriates.
Industrial conflict – Causes, Types, Prevention and Settlement.
e-HRM; Aspects of e-HRM, e-Job design & Analysis, Ethical issues in employment

8 Hours

Course Outcomes (CO):

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

CO 1 Describe the basic concepts of HRM & HRP.
CO 2 Elucidate the HRM functions of recruitment, selections, appraisal etc.
CO 3 Apply the training, development and compensation methods in HRD.
CO 4 Identify the employee grievances and to spell out the remedial measures.
CO 5 Infer the concepts of e-HRM and I-HRM.
**TEXTBOOK:**

**REFERENCE BOOKS:**
2) Human Resource Management-Flippo
4) Human Resource Management – Aswathappa K HPH

**MOOC/NPTEL Resources:**
1) http://edx.nimt.ac.in/courses/course-v1:nimtX+PGDM1212+2017_H1/about
2) http://nptel.ac.in/courses/122105020/

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### Course Articulation Matrix

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1: Low  2: Medium  3: High

**Scheme of SEE Question Paper**

There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

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### LINGUISTICS & LANGUAGE TECHNOLOGY

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</table>

**Course Learning Objectives:**

By the end of the course, students should be able to:
1. Introspect about the consciousness in one’s language
2. Learn pronunciation and how the process helps to communicate effectively.
3. Build contextual speech and writing with the pedagogy in sentence structure.
4. Improve skill of applying language to enunciate words.
5. Progress on the speech aspects by understanding the acquisition of Second Language.
UNIT – I

Introduction to Linguistics:
Broad understanding of Linguistics, Language and characteristic features, Scientific Language, Levels of Linguistic Analysis (Phonetics, Phonology, Morphology, Syntax and Semantics); Approach to Linguistics (Traditional, Structural and Cognitive) 7 Hours

Phonology and Morphology:
Perspectives in Linguistics, Phonemes, Allophones, Phonemic Analysis, Morphology and Morphemes, Word building process, Morphological Analysis. 8 Hours

UNIT – II

Syntax:
Constituent structure (Simple Sentence, Noun Phrase, Verb Phrase, Prepositional Phrase, Adjective Phrase, Adverb Phrase, Structure Rules), Tree Diagrams, Case. 10 Hours

Meaning:
Semantics & Pragmatics, Text and Discourse. 6 Hours

UNIT – III

Sociolinguistics & Psycholinguistics:
Notion of Language Variety, Languages in Contact, Language and Mind, Error Analysis. 8 Hours

Course Outcomes:
By the end of the course, students will be able to:
1. Understand the importance of language and its facets.
2. Demonstrate knowledge of sounds and competence in process of word building.
3. Evolve to reason the constituent parts of a sentence.
4. Understand the techniques of how ‘meaning’ is applied.
5. Analyse errors in day-to-day-conversations and how language is related to society.

Course Articulation Matrix:

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L: Low  M: Medium  H: High

REFERENCE BOOKS:

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INTRODUCTION TO PYTHON PROGRAMMING

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<td>39</td>
<td>Credits</td>
<td>03</td>
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</table>

Prerequisites:
Student must have fundamental knowledge of procedure-oriented programming.

Course Learning Objectives (CLOs):
At the end of the course student should be able to:
- Construct Python programs using data types and looping.
- Design object-oriented Python programs using classes and objects.
- Design useful stand-alone and CGI applications in Python.

UNIT - I

INTRODUCTION: Introduction to python, Installing Python; basic syntax, interactive shell, editing, saving, and running a script. The concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages. Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation.

STRING MANIPULATIONS: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa, Binary, octal, hexadecimal numbers

LISTS, TUPLES, AND DICTIONARIES: Basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries.

15 Hours

UNIT – II

FUNCTIONS: Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions

CLASSES AND OOP: Classes, objects, attributes and methods; defining classes; design with classes, data modelling; persistent storage of objects, inheritance, polymorphism, operator overloading (_eq_, _str_, etc); abstract classes; exception handling, try block

15 Hours
UNIT – III

FILE HANDLING: Manipulating files and directories, Reading from Text Files, Writing to Text Files, Reading from Binary Files, Writing to Binary Files, Seeking Within Files, Creating and Reading a formatted file (csv or tab-separated).

GRAPHICAL USER INTERFACES: event-driven programming paradigm; creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames Simple CGI form

9 Hours

Course Outcomes:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Outcome (CO)</th>
<th>Bloom’s Taxonomy Level (BTL)</th>
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<tbody>
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<td>Demonstrate the basics of Python programming like data types and looping</td>
<td>L2</td>
</tr>
<tr>
<td>C8X38.2</td>
<td>Apply the basic data structures in solving the problems</td>
<td>L3</td>
</tr>
<tr>
<td>C8X38.3</td>
<td>Experiment with usage of functions in a given problem</td>
<td>L3</td>
</tr>
<tr>
<td>C8X38.4</td>
<td>Develop Objects by creating classes and apply object-oriented features</td>
<td>L3</td>
</tr>
<tr>
<td>C8X38.5</td>
<td>Develop applications in Python using File Programming &amp; User Interface</td>
<td>L3</td>
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Table: Mapping of COs to PI, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
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Mapping Course Outcomes with Programme Outcomes:

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(L/1=Low30%-49%, M/2=Medium50%-69%, H/3=High>70%)

TEXTBOOK:


ADDITIONAL RESOURCES:

1. Think Python. PDF is free.
BIOFUEL ENGINEERING

<table>
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Prerequisites: Nil
Co-requisites: Nil

Course Learning Objectives:
The objective of this course is
- To learn the fundamental concepts of biofuels, types of biofuels, their production technologies.
- To learn the concepts of feedstock utilization and energy conversion technologies.

UNIT – I

LIQUID BIOFUELS
Production of biodiesel: Sources of Oils – edible and non edible; Esterification and Transesterification. Free fatty acids; saponification; Single step and two step biodiesel production. Catalysts for biodiesel production – homogeneous (alkali/acidic) and heterogeneous; Lipase mediated process. General procedure of biodiesel production and purification Quality Control Aspects: GC analysis of biodiesel, fuel property measurements, ASTM (D-6751) and Indian standards (IS15607). Algal Biodiesel production.
Production of Bioethanol: Bioethanol production using Sugar; Starch and Lignocellulosic feedstocks; Pretreatment of lignocellulosic feed stock

UNIT – II

BIOHYDROGEN AND MICROBIAL FUEL CELLS
Enzymes involved in H₂ Production; Photobiological H₂ Production: Biophotolysis and Photofermentation; H₂ Production by Fermentation: Biochemical Pathway, Batch Fermentation, Factors affecting H₂ production, Carbon sources, Detection and Quantification of H₂, Reactors for biohydrogen production.
Microbial Fuel cells: Biochemical Basis; Fuel Cell Design: Anode & Cathode Compartment, Microbial Cultures, Redox Mediators, Exchange Membrane, Power Density; MFC Performance Methods: Substrate & Biomass Measurements, Basic Power Calculations, MFC Performance: Power Density, Single vs Two-Chamber Designs, Wastewater Treatment Effectiveness; Advances in MFC.
UNIT – III

RECOVERY OF BIOLOGICAL CONVERSION PRODUCTS

Biogasification of municipal solid waste: Anaerobic processing; Types of digesters, Biogas plant in India.

Thermochemical processing: Planning an incineration facility, Incineration technologies: Mass burning system; Refuse derived fuel (RDF) system; modular incineration; Fluidized bed incineration; energy recovery; Fuel production through biomass incineration, Pyrolysis and gasification, hydrothermal processing.

Course Outcomes:
At the end of this course, student should be able to:
1. Mark the significance of biofuels and raw materials and Identify suitable feedstock for production of biofuels.
2. Illustrate the production of liquid biofuels from various feed stocks.
3. Demonstrate production of biohydrogen using microbial sources.
4. Extend the concepts of microbial fuel cells towards development of specific application.
5. Understand and apply the concepts of biochemical processing to harvest energy from waste products/streams.

Mapping of POs & COs:

<table>
<thead>
<tr>
<th>PO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
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REFERENCE BOOKS:

SEE QUESTION PAPER PATTERN:

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SOLID WASTE MANAGEMENT

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</table>

**Prerequisites:** Nil

**Co-requisites:** Nil

**Course Learning Objectives:**
The objective of this course is
1. To learn types of solid wastes, collection, treatment and disposal methods.
2. To understand various processing techniques and regulations of treatment and disposal.

**UNIT – I**

**INTRODUCTION TO SOLID WASTES AND ITS SEGREGATION & TRANSPORTATION**
Solid waste – Definition, Sources of waste, Classification of Solid waste, Characteristics of Solid Waste (Physical, Chemical, Biological), Solid waste problems – impact on environment and health. Concept of waste reduction, recycling and reuse.

**Waste collection and segregation:** Solid waste generation, Onsite handling and segregation of wastes at source, Collection and storage of municipal solid wastes, Equipment used and manpower required in collection, Collection systems and routes.

**Transportation:** Transfer stations: types, location, maintenance, Methods and means of transportation.

**UNIT – II**

**PROCESSING TECHNIQUES, RECOVERY OF RESOURCES AND WASTE DISPOSAL**
Processing Techniques: Unit operations for separations and processing, mechanical and thermal volume reduction, Incineration of solid wastes – process and types of incinerators (liquid injection, rotary kiln and fluid bed), Biological processing – composting, vermicomposting, biomethanation, fermentation, Drying and dewatering of wastes.

**Recovery of Resources:** Heat recovery in incineration process, energy recovery and conversion of products from biological processes.

Dumping of solid wastes, Landfills – Types, site selection, preliminary design, operation, case study, Advantages and disadvantages of landfills, Leachate and landfill gases: Collection and treatment, Landfill disposal for hazardous wastes, biomedical waste.
UNIT – III

SOLID WASTE MANAGEMENT RULES AND PLANNING ISSUES
Planning and developing a site for solid waste management, Site Remediation: Assessment and Inspection, Remedial techniques, Siting guidelines.

Course Outcomes:
At the end of this course, the student will be able to
1. Identify the sources, classification and characteristics of solid wastes
2. Develop insight into the collection, transfer, and transport of solid waste.
3. Apply waste processing techniques and recovery of resources from the waste.
4. Select the alternatives of solid waste disposals and its impacts.
5. Acquire knowledge about solid and hazardous waste management legislative rules.

Mapping of POs & COs:

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<th>PO</th>
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NUMBER THEORY

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Course Learning Objectives:

1. Understand the divisibility of integers and study of prime numbers.
2. Understand the basic properties of congruences.
3. Study Fermat's little theorem and understand Euler's function.
4. Study the existence of primitive roots and quadratic residues.
5. Study different methods to partition the particular types of integers.

UNIT - I

DIVISIBILITY AND PRIMES

8 Hours

UNIT – II

CONGRUENCES

CONGRUENCES WITH A PRIME-POWER MODULUS

16 Hours

UNIT - III

PRIMITIVE ROOTS
Existence of primitive roots: order of an integer modulo n, primitive roots for primes. Quadratic residues, Legendre symbol, Euler's criterion, Gauss lemma. SUMS OF SQUARES, FERMAT’S LAST THEOREM
Sums of two squares, Sums of four squares, The Pythagoras theorem, Pythagorean triples and their classification, Fermat's Last Theorem (Case n = 4).

15 Hours

Course Outcomes:

1. Prove results involving divisibility and greatest common divisors.
2. Solve systems of linear congruences and find integer solutions to specified linear diophantine equations.
3. Apply Euler – Fermat's theorem to prove relations involving primenumbers, apply the Wilson's theorem.
4. Apply Euler'sCriterion, Gauss lemma effectively.
5. Apply Fermat's last theorem.
Mapping of POs & COs:

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L : Low    M: Medium   H : High

TEXTBOOKS:

REFERENCE BOOKS:

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PCB DESIGN

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Pre-requisites:
Basic electrical and electronics engineering.

Course Learning Objectives:
1. To enable students to gain knowledge of Schematic Design techniques & PCB design techniques
2. To expose students to complete PCB Design & manufacturing process

List of Experiments
- Introduction to PCB design tool: building a schematic circuit and layout
- Exploring the PCB design tool by creating new components, using existing components and footprint, simulation features, Active & Passive Components
- Drawing a PCB layout in a single layer with constraints such as board area, track width, packages, via etc
- Creating a double layer PCB for a given schematic circuit
- Creating and using different component package types
- Fabrication of single and double layer PCB on a copper clad board using hatching/engraving technique
- Handling PCB prototype machine using Mach3 CNC tool for the PCB prototype.
**Detailed Course Plan**

**Lab 1**
Introduction to PCB design tool: building a schematic circuit.

**Lab 2**
Creating Library & Components, using existing components and footprint, simulation features, Active & Passive Components.

**Lab 3**
Designing a single layer PCB for given schematic circuit diagram, Gerber file generation.

**Lab 4**
Designing a double layer PCB for given schematic circuit diagram, Gerber file generation.

**Lab 5**
Simulating digital and analog circuits for given test cases.

**Lab 6**
Handling programmable microcontroller circuit in the simulation environment of schematic editor.

**Lab 7**
Defining a footprint for a component in the PCB layout.

**Lab 8**
Fabrication of single layer PCB using PCB prototype machine – Generating bit file in Copper Cam tool.

**Lab 9**
Fabrication of single layer PCB using PCB prototype machine – Setting up Mach3 CNC tool.

**Lab 10**
Fabrication of double layer PCB using PCB prototype machine – Generating bit file in Copper Cam tool.

**Lab 11**
Fabrication of double layer PCB using PCB prototype machine - Setting up Mach3 CNC tool.

**Lab 12**
Component placement and soldering.

**Lab 13**
Desoldering and testing.

**Scheme of SEE Examination**
It is a 3-Hour exam at the end of the semester where the student is to demonstrate the PCB designing process.
### Course Outcomes:
At the end of the course the student will be able to
1. Draw schematic circuit and create PCB layout for single or multilayer PCB
2. Fabricate single and double-layer PCB using Mach3Mill operated CNC machine.

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### INNOVATION AND ENTREPRENEURSHIP

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<tr>
<td>Total Hours</td>
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<td>Credits</td>
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### Prerequisites:
The student must have learnt basics of Engineering concepts, applications and business as a whole.

### Course Learning Objectives:
This Course will enable students to,
1. Understand Technological Innovation
2. Understand Innovation management and the difference between Invention and Innovation.
3. Appreciate the importance of Innovation as management process and Innovation management techniques.
4. Define Innovation system and Understand the importance of Technology management and Transfer.
5. Identify Technological Entrepreneurship and its types and Understand the Institutional support provided for Entrepreneurs

---

### UNIT – I

#### INTRODUCTION TO TECHNOLOGICAL INNOVATION

#### INTRODUCTION TO INNOVATION MANAGEMENT
Innovation Management Through Management of Knowledge and Education – Types of Learning - Difference Between Innovation and Invention - Types and Characteristics of Innovation.

#### INNOVATION AND COMPETITIVENESS
Case Study – Barriers for Innovation and Competitiveness.
## UNIT – II

### INNOVATION AS A MANAGEMENT PROCESS  
14 Hours

Activities to enhance companies capacity for innovation – Management of Technological Innovation: Corporate Perspective, National Perspective, Theoretical Perspective and Individual Perspective - Challenges in Technological Innovation Management - Case Study in Technological Innovation Management - Innovation Management Techniques (IMTs).

### INNOVATION SYSTEMS

The Concept of Innovation Systems - Innovation Systems: Sectoral, Regional, National.

### TECHNOLOGY MANAGEMENT AND TRANSFER

Technology Transfer - Impacts of MNCs in technology transfer -

## UNIT – III

### INTRODUCTION TO TECHNOLOGICAL ENTREPRENEURSHIP  
11 Hours

Types of Entrepreneurship: Mixed Entrepreneurship, Pure Entrepreneurship, Social Entrepreneurship, Collaborative Entrepreneurship, Internal Entrepreneurship, External Entrepreneurship - Sustainable Entrepreneurship -

### INSTITUTIONAL SUPPORT

Business Incubator (Bi) - Determination of the Five Incubator Services - Incubation Centres in India – Atal Incubation Centre – Startup India - NSIC, KIADB, KSFC.

### Course Outcomes (CO):

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

<table>
<thead>
<tr>
<th>CO 1</th>
<th>Describe technological innovation and its key features for business.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 2</td>
<td>Describe innovation management and difference between invention and innovation.</td>
</tr>
<tr>
<td>CO 3</td>
<td>Explain innovation as a management process, its management and perspectives. Understand Innovation management techniques.</td>
</tr>
<tr>
<td>CO 4</td>
<td>Explain innovation system, technology management and transfer.</td>
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<tr>
<td>CO 5</td>
<td>Explain technological entrepreneurship and institutional support.</td>
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### TEXTBOOK:


### REFERENCE BOOKS:

Course Articulation Matrix:

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1: Low  2: Medium  3: High

Scheme of SEE Question Paper
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

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AUTOMOTIVE ENGINEERING

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Course Learning Objectives:
This Course will enable students to,

1. Get an idea on the different components of an engine and its types with lubrication system.
2. Understand the fuel supply system and ignition systems used in automobiles.
3. Demonstrate the working of transmission system.
4. Explain the importance of suspension system, steering geometry and drives in automobiles.
5. Know the concept of braking system, tyres and emission control.

UNIT – I
ENGINE COMPONENTS AND COOLING & LUBRICATION SYSTEMS:
SI & CI engines, Cylinder-arrangements and their relative merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams, Choice of materials for different engine components, engine positioning, cooling requirements, methods of cooling, thermostat valves, different lubrication arrangements, crankshaft/flywheel position sensor, accelerator pedal sensors, engine coolant water temperature sensor.

8 Hours

FUEL SUPPLY SYSTEMS FOR SI AND CI ENGINES: Fuel mixture requirements for SI engines, types of carburetors, simple carburetor, multi point and single point fuel injection systems, CRDI, fuel transfer pumps: AC Mechanical Pump, SU Electrical Pumps, injectors, Fuel gauge sensor, Throttle position sensor, Mass air flow sensors.

5 Hours
**IGNITION SYSTEMS:**
Battery Ignition systems, magneto Ignition system, Transistor assisted contacts. Electronic Ignition, Automatic Ignition advance systems, Lighting systems, Rain/Light sensors, starting device (Bendix drive)  

**UNIT – II**

**POWER TRAINS:**

**DRIVE TO WHEELS:**
Propeller shaft, universal joints, Hotchkiss. and torque tube drives, differential, rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe-in & toe-out, condition for exact steering, power steering, over steer, under steer & neutral steer, Steering angle sensors, numerical problems.

**SUSPENSION AND SPRINGS:**
Requirements, leaf spring, coil spring, Torsion bar suspension systems, independent suspension for front Wheel, Air suspension system.

**UNIT – III**

**BRAKES:**
Types of brakes, mechanical, compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, Drum brakes.

**TYRES**
Desirable tyre properties, Types of tyres.

**AUTOMOTIVE EMISSION:**

**Course Outcomes (CO):**
At the end of the course the student will be able to

| CO 1 | Describe and demonstrate the layout of an automobile and components of an automobile engine. Explain cooling and lubrication systems. |
| CO 2 | Explain and demonstrate the fuel supply and Ignition systems for SI and CI engines. |
| CO 3 | Describe and demonstrate the transmission system |
| CO 4 | Explain and demonstrate the components of drive to wheel and suspension system, calculate the parameters of steering geometry. |
| CO 5 | Describe and demonstrate automotive braking system. Explain types and construction of tyres and wheels. Explain the significance of automotive emissions and its controlling methods. |
TEXTBOOKS:


REFERENCE BOOKS:

4. Automotive Mechanics, Joseph Heithner 2000
5. Automobile Mechanics by N. K. Giri, Khanna publishers 2002

List of proposed Experiments in Automotive Laboratory: 4 Hours

1. Study of Automotive - Chassis & superstructure/body and its functions. Also involves study of cut section of wheel & tyres (bias and radial types).
2. Study of more commonly used tools and equipment in automotive shop.
3. Study of carburetors and petrol & diesel fuel injection systems
4. Demonstration and study of Front axle and steering system
5. Demonstration and study of various suspension systems
7. Power train - Study of clutch mechanism. Demonstration and study of dry friction clutches - Single plate & multi-plate types
8. Power train - Demonstration and study of transmission system - Gear box
9. Power train - Demonstration and study of Universal joints, propeller shaft, final drives, differential, and rear axles
10. Demonstration and study of brake mechanism (hydraulic type) and study of disc and drum brakes
11. Field visit to Automotive Servicing Station - Study of electrical system, wheel alignment (measuring and adjustment of castor, camber, king-pin inclination, toe-in and toe-out), automotive emission control systems.

(The details of each experiment to be given out as handout to each student or may be uploaded in Intranet)
## Course Articulation Matrix:

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<thead>
<tr>
<th>Course Outcomes (CO)</th>
<th>Program Outcomes (PO)</th>
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1: Low  2: Medium  3: High

### Scheme of SEE Question Paper

There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

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## DISASTER MANAGEMENT

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### Course Learning Objectives:

1. Understand difference between Disaster, Hazard, Vulnerability, and Risk.
2. Know the Types, Trends, Causes, Consequences and Control of Disasters
3. Apprehend Disaster Management Cycle and Framework.
4. Know the Disaster Management in India
5. Appreciate Applications of Science and Technology for Disaster Management.

### UNIT – I

**Understanding Disasters:** Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.

**Types, Trends, Causes, Consequences and Control of Disasters:** Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters

15 Hours
UNIT – II


Disaster Management in India: Disaster Profile of India – Mega Disasters of India and Lessons Learnt, Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter-Governmental Agencies

UNIT – III

Applications of Science and Technology for Disaster Management: Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non Structural Mitigation of Disasters S&T Institutions for Disaster Management in India

Case Studies: Study of Recent Disasters (at local, state and national level)
Preparation of Disaster Risk Management Plan of an Area or Sector, Role of Engineers in Disaster Management

Course Outcomes:
After completion of this course the students will be able to
1. Explain Concepts, Types, Trends, Causes of Disasters
2. Describe Consequences and Control of Disasters
3. Explain Disaster Management Cycle and Framework:
4. Explain the lesson learnt from the disasters in India and discuss the financial mechanism, roles and responsibilities of Non-Government and Inter-Governmental Agencies for Disaster management
5. Describe the Applications of Science and Technology recent disasters, role of engineers for Disaster Management and prepare a report of Disaster Risk Management Plan.

Mapping of POs & COs:

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</table>

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
REFERENCE BOOKS:
3. World Disasters Report, 2018. International Federation of Red Cross and Red Crescent, Switzerland
9. Disaster Management Act 2005, Publisher by Govt. of India
13. Disaster Mitigation in Asia & Pacific, Asian Development Bank

Note: There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

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INTRODUCTION TO YOGA

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Course Learning Objectives:

This Course will enable students to
1. To give a brief history of the development of Yoga.
2. Identify names of different classical texts on Yoga.
3. To illustrate how Yoga is important for healthy living.
4. Explain the Asanas and other Yogic practices.
5. To explain, how Yoga practices can be applied for overall improvement.
UNIT - I

Chapter-1: Introduction to Yoga: Meaning and initiation, definitions and basis of yoga, History and development, Astanga yoga, Streams of yoga. Yogic practices for healthy living. General guidelines for Yoga practices for the beginners: Kriyas, Asanas, Pranayama, Meditation. 8 Hours

Chapter-2: Classification of Yoga and Yogic texts: Yogasutra of Patanjali, Hatha yogic practices- Asanas, Pranayama, Dharana, Mudras and bandhas, satkarmas. Specific guidelines for practice of Pranayama. 7 Hours

UNIT – II

Chapter-3: Yoga and Health: Concept of health and diseases-Yogic concept of body – pancakosa viveka, Concept of disease according to Yoga Vasistha. Yogic concept of healthy living- rules & regulations, yogic diet, ahara, vihara. Yogic concept of holistic health. 8 Hours

Chapter-4: Applied Yoga for elementary education: Personality development- physical level, mental level, emotional level, intellectual level. Specific guidelines and Yoga practices for - Concentration development, Memory development, IQ development, Culturing the emotion. 4 Hours

UNIT – III

Chapter-5: Yoga and physical development: Mind-body, Meditation, Yogasanas and their types. Different Yoga practices and Benefits. 8 Hours

Specific guidelines for practices of meditation. Specific guidelines and Yoga practices for – Flexibility, Stamina, Lung capacity, Endurance (Surya Namaskara). 4 Hours

Course Outcomes:
At the end of the course, the student will be able to
1. Understand a brief history of the development of Yoga.
2. Know important practices and principles of Yoga.
3. Explain how Yoga is important for healthy living.
4. Practice meditation to improvement of concentration etc.
5. Have knowledge about specific guidelines of yoga practices.

Program Articulation Matrix:

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201
### PHILOSOPHY

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### Course Learning Objectives:

1. It is believed that ideas in Humanities and Social Sciences can provide a new understanding based on which one can move to overcome the current problems, both at the individual level as well as at the societal level.

2. It was felt that there is a need to introduce an orientation course for humanities courses in general and for philosophy courses in particular. The underlying reason for this is that while students till 10th class have a natural familiarity with humanities, this however gets discontinued subsequently.

3. This course is expected to relate philosophy to literature, culture, society and lived experience can be considered. This is in addition to training students in already available philosophical systems. Instead of only theory or only practical courses attempt can be made to combine both theory and practice.

4. This course is expected to bridge the gap between theory and practice by making the courses interactive. Along with projects, this course will have more illustrations that would invite students into the subject.

#### UNIT – I

The difference between knowledge (Vidya) and Ignorance (Avidya):

a) Upanishads;

b) Six systems orthodox and Heterodox schools of Indian philosophy.

c) Greek philosophy:
Origin of the universe:
- Nasidiya Sukta: “Who really knows?”
- Brhadaranyaka Upanishad; Chandogya Upanishad: Non-Self, real and unreal
- Taithriya Upanishad: Siksha Valli
- Plato’s Symposium: Lack as the source of desire and knowledge.
- Socratic method of knowledge as discovery
- Language: word as root of knowledge (Bhartrahari’s Vakyapadiyam)
- Fourteen Knowledge basis as a source of Vidya: Four Vedas, six auxiliary sciences (vedangas); Purana, Nyaya, Mimamsa and Dharma Sastras.  
  
UNIT – II

Knowledge as Power: Francis Bacon. Knowledge as both power and self-realization in Bagavad Gita.
Knowledge as Oppression: M. Foucault. Discrimination between Rtam and Satyam in Indian Philosophy.
Knowledge as invention: Modern definition of creativity; scientific activity in the claim that science invents new things at least through technology.

UNIT – III

Knowledge about the self, transcendental self; knowledge about society, polity and nature
Knowledge about moral and ethics codes
Tools of acquiring knowledge: Tantrayuktis, a system of inquiry (Caraka, Sushruta, Kautilya, Vyasa)

REFERENCE BOOKS:
3. Sathaye, Avinash, Translation of Nasadiya Sukta
5. Plato, Symposium, Hamilton Press

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OVERVIEW OF INDIAN CULTURE AND ARTS

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Course Learning Objectives:

1. To understand the relevance of Culture in Human Life, dynamism of Indian Culture and Arts through ages.
2. To develop awareness about Indian Society, Culture and Arts under Western rule and also know about the events of Indian National Movement, growth of languages and their role in the life and culture of Indian society.
3. To understand different forms of Indian Painting, Performing Arts and Architecture.
UNIT – I

Culture:
Introduction, Culture and Civilization, Culture and Heritage, General Characteristics of Culture, Importance of Culture.

Indian Culture through Ages:
Importance of Knowledge of History
Ancient India – Popular Religious Reforms; Persian and Macedonian invasions and its impact on Indian Culture, Development of Culture and Arts during Muryan Empire (Ashoka), Guptas, South Indian Dynasties – the Pallavas, the Cholas, Nalanda as a Centre of Learning, Christianity in India.

Medieval India – Life of People under Delhi Sultanate, Rise of Islam and Sufism, Political Scene of India, Cultural Development, Bhakti Movement, Folk Arts, Painting, Music, Rise of Modern Indian Languages – New Faiths

UNIT – II


Languages and Literature – Role of Sanskrit: Vedas, Upanishads, Ramayana and Mahabharata, Puranas, other Sanskrit Literature, Buddhist and Jain Literature, Dravidian Languages and Literature, North Indian Languages and Literature, Role of Christian Missionaries.

UNIT – III

Painting, Performing Arts and Architecture, Indian Painting, Music, Dance, and Drama, Indian Architecture.

Course Outcomes:
1. The student will be able to examine how the culture has a very important role in human life and growth of human civilization and have a general awareness on historical perspective of growth of Indian Culture and Arts.
2. The student will know about the impact of Western Rule in India and Indian Struggle for Freedom and also its impact on Indian Culture and Arts and able to appreciate and the role of language in connecting people, growth of culture and arts beyond the barriers of religion and ages.
3. The students will be able to take interest in learning these forms of arts, and also appreciate and preserve them for the future generations feeling proud of Indian Culture, Arts and Architecture.

Mapping of Pos & Cos:

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L: Slight (Low)   M: Moderate (Medium)    H: Substantial (High)

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PRINCIPLES TO PHYSICAL EDUCATION

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**Course Learning Objectives:**

This Course will enable students to

1. Appreciate and understand the value of physical education and its relationship to a healthy active lifestyle.
2. Work to their optimal level of physical fitness.
3. Show knowledge and understanding in a variety of physical activities and evaluate their own and others’ performances.

**UNIT - I**

**History of Physical Education** - Olympic games, Modern Olympic games, Olympic Ideals & Objectives, Olympic Symbols, Olympic Flag, Olympic Emblem, Olympic Motto, Olympic Flame, Asian games

**International Olympic Committee (IOC), Indian Olympic Association (IOA)**

**Sports awards** - Eligibility, Objectives & Criteria

**Yoga** - Meaning and Importance

**World Health organization (WHO)**

10 Hours

**UNIT – II**

**Concept of Health** - Meaning of Health, Health Definition, Factors Affecting Health, Qualities of Healthy Person. Health Hazards of College Students, Physical Fitness and Exercises.

**Food and Nutrition** - Food & Nutrition Defined, Nutrients and their Functions - i) Proteins ii) Carbohydrates iii) Fats iv) Vitamins

**Balanced Diet & Malnutrition**

**Health Education** - Meaning of Health Education, Health Education Defined, Scope of Health Education, Importance of Health Education.

**Posture** - Concept of Posture, Correct Postures, Common Postural Defects

**First Aid** - First Aid Defined, Need and importance of First Aid, The Requisites of First Aid, Scope of First Aid, Qualities of a First Aider, Fundamental Principles to be followed and the Duties to be performed by the First Aider, First Aid in Different Cases.

**Physical Education** - Concept of Physical Education, Physical Education Defined, Importance of Physical Education, Scope of Physical Education, Aims and Objectives of Physical Education.

**Teaching Aid in Physical Education**

**Competition** - Introduction, Types of competition, Knock out, League or Round Robin Tournament.

12 Hours

**UNIT – III**

**Training in Sports** – Meaning, Principles, Warming Up & Limbering Down

**Importance of Anatomy and Physiology in Physical Education**, Oxygen Debt and Second wind

Measurement & specification of various playing fields – Cricket, Volley Ball, Basket Ball, Badminton, Ball Badminton, Foot Ball, Hand Ball & their basic playing skills.

Course Outcomes:
At the end of the course, the student will be able to
1. Demonstrate an understanding of the principles and concepts related to a variety of physical activities.
2. Apply health and fitness principles effectively through a variety of physical activities.
3. Support and encourage others (towards a positive working environment).
4. Show self-motivation, organization and responsible behavior.

TEXT AND REFERENCE BOOKS:
1. A. K. Uppal, “Physical Education and Health”
2. M. L. Kamlesh, “Fundamental Elements of physical Education”
4. V. K. Sharma, “Health and Physical Education”

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INTRODUCTION TO JAPANESE LANGUAGE

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Course Learning Objectives:
The objective of the course is to learn basic Japanese Language for every day living, including the introduction to Japanese Culture, Tradition, Festivals etc. In this session, Speaking, Reading, writing and listening will be taught at basic level. Short videos of Movies, Drama, Music, Festivals and food will be briefly explained.

The course will enable students to,
1) Have basic spoken communication skills
2) Write Simple Sentences
3) Listen and comprehend basic Japanese spoken Japanese
4) Read and understand basic Japanese characters including Kanji

UNIT - I

(Lessons 1-6)
Grammar – Introduction, Alphabets, Accents, Noun, Pronoun, Present Tense, Past tense
Vocabulary – Numbers, Days, week days, months, Seasons, Nature, Dialogs and Video Clips

UNIT - II

(Lessons 7-13)
Communication skills – Time, Addective, Seasons, Conversation, Q&A
Hobby, 5-W/1-H, Entering School/Company, Body Parts, Colors, Features etc
UNIT - III

Japanese Counting System, Birth/Death, Dialogs (Going to Party, Restaurant), My day, Success/Failure, Kanji Characters, and sentence making, Video Clips

14 Hours

Course Outcomes:

At the end of the course, students will be able to
1. Understand Simple words, expressions and sentences, spoken slowly and distinctly
2. Read and Understand common words and sentences
3. Ask Basic questions and speak in simple sentences
4. Write Hiragana/Katakana and Kanji(120) characters.

Contents

UNIT - I

Lesson 1  Greetings & Self Introduction / Yes, No / This is a Book  p1
Lesson 2  Like, Dislike / Verb1 食べる Eat, のむ Drink / Days, Week  p4
Lesson 3  About Myself / いくらですか How much is this?  p7
Lesson 4  Existence ある いる/ Direction  p9
Lesson 5  Verb2 行く Go, する Do / Nature 自然/ Dialogue “Hanami”  p11
Lesson 6  Verb3 来る Come / The Past Tense / Dialogue “Trip to Asakusa”  p14

UNIT - II

Lesson 7  Time 時間 / Family 家族/ Dialogue “The Family Photo”  p17
Lesson 8  Adjective / Adj. Past & Negation / Adj. (Become, Please) / Season  p19
Lesson 9  Year / Entering School, Company / Dialogue “At the Market”  p23
Lesson 10 Verb4 できる Can / May I ~ / Comparison 比較  p25
Lesson 11 Dialogue “5W1H” / Verb5 ほしい Want, ～たい Want to  p28
Lesson 12 Dialogue “Go to KABUKI” / My Hobby is～/ East-west-south-north  p32
Lesson 13 Body からだ / Dialogue “Colour of Shirt” / Features of Body  p35

UNIT - III

Lesson 14 Counter Suffix / The Progressive Form  p39
Lesson 15 Birth & Death / Dialogue “Moshi-Moshi” / Must do ~  p42
Lesson 16 Dialogue “Going to the Party” / Show the Way道案内 / It May ~  p45
Lesson 17 Dialogue “Going for Lunch” / The Future Tense / A Letter to A san  p48
Lesson 18 I Have Experienced ~ / Colloquial Dialogue / Should ~  p52
Lesson 19 Verbs Which are Often Used / My Day / Order 順番  p55
Lesson 20 Success & Failure / Dialogue “What’s the Matter?” / The Final Exercise  p58

Appendix

Particle ..............................  p62
Numbers ..............................  p63
Verbs .................................  p64
ENVIRONMENTAL HYGIENE, SANITATION AND WASTE MANAGEMENT

<table>
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Course Learning Objectives:

1. Creation of awareness among students health issues and Swachh Bharath mission and the consequent responsibilities.
2. To understand the culture cleanliness, engineering applications in creation of ODF (Open defecation free) concept, Importance of legal & cultural issues related to Environmental Hygiene.
3. To know the importance of sanitation, gender sensitive sanitation issues & use of engineering technology in construction of toilets.
4. To know the importance of waste management system, wastewater audit and waste water treatment process.
5. To study the role of student in Swachh Bharata Abhiyan, solid and waste water treatment process.

UNIT - I

Prospective: Environmental Hygiene (EH), Sanitation, Solid Waste and Wastewater:

6 Hours

Sociology of environmental hygiene management, solid waste and waste water and impacts
Open Defecation-Habits & attitude towards waste-Goals of SBA. Community Consciousness and Engagement on Sanitation Aspects, Roles & Responsibilities, Job Charts, Frequency, Schedules and Timelines in Swachhata Management, Culture of Cleanliness (Swachh Bharat Abhiyan), Behaviour Change Communication, Role of Habits and Attitudes in Environmental Hygiene Management, Waste and Wastewater Disposal; Change Management.

8 Hours

UNIT - II

Infrastructure for Sanitation:

Containment-Preparation of toilets –Toilet Types Evaluation of Construction and Maintenance of Community, Public, Institutional and Individual Sanitation Infrastructure Toilets-Proportion and Number of toilets, Gender Sensitive Sanitation Facilities, Ramps for

**Solid Waste Management:**


**UNIT - III**

**Waste & Wastewater Audit:**


**Swachh Bharath Mission and Inclusivity:**

Swacch Bharath Mission in rural & Urban Context-Gender Issues in sanitation. Role of women in Sanitation

**Course Articulation Matrix:**

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L: Slight (Low)  M: Moderate (Medium)  H: Substantial (High)

**REFERENCE BOOKS:**

1) Water and Wastewater Treatment: A Guide for the Non-engineering Professional by Joanne E. Drinan and Frank Spellman
2) Solid Waste Management: An Indian Perspective by M.S. Bhatt and Asheref Illiyan
3) Solid Waste Management: Present and Future Challenges by Jagbir Singh
4) Solid Waste Management: An Indian Perspective by M. S. Bhatt
5) Management of Municipal Solid Waste by T. V. Ramachandra
6) Wastewater Treatment Plants: Planning, Design and Operation by Syed R. Qasim

**WEBSITE REFERENCE:**

1) Swachhbbharatmission.gov.in/
3) https://www.swachhsurvekshan2018.org/
4) https://zerowasteurope.eu/
5) www.zerowasteindia.in/
INTRODUCTION TO GERMAN LANGUAGE

Course code: 18HU8X74 CIE Marks: 50
Teaching Hours/Week (L:T:P): (3:0:0) SEE Marks: 50
Total Hours: 39 Credits: 03

Course Learning Objectives:

UNIT - I

Introduction: Mein Name ist (saying who you are, greeting people and saying goodbye, asking people where they come from and where they live. Language point: I and you), Lesen der politischen Karte der Welt, Nationalitaeten und Spachen, Die Uhrzeit (The time) telling time and talking about daily routine, Tage der Woche, die Monate, die vier Jahreszeiten, die Jahre

Mir geht es gut: Asking people how they are, saying how you are, saying which cities and countries people come from, Language points: verb endings),

Wie schreibt man das (how do you write that?) Counting from 1-100 and above, alphabet, spelling our names and words, talking about us and them. Language points: Yes-no questions

Artikel (Articles): As in English, there are definite (der/die/das) and indefinite (ein/eine) articles:
the □ der/die/das; a/an □ ein/eine
Die vier Fälle (The four cases): Nominativ, Akkusativ, Dativ, Genitiv(Not in level A-1)
Deklination des bestimmten Artikels der/die/das
Deklination des unbestimmten Artikels ein/eine
(Deklination/Declension: the variation of the form of a noun, pronoun, or adjective, by which its grammatical case, number, and gender are identified)

Deklination von Substantiven (Declension of nouns) (Singular and Plural)
(German nouns are declined by attaching certain endings to them, according to case, number and gender. This helps to differentiate between subjects, objects and indirect objects).

Nominativ und Akkusativ(nominaive and accusative cases)
The verb determines the case of the noun. Some verbs only go with the nominative, others only with the accusative (or the dative). Thus, German verbs are either transitive or intransitive.
(nominaive and accusative cases) Intransitive Verben (intransitive verbs) Transitive
Verben (transitive verbs)

Negation „kein/e/er“ (negation with „kein/e/er“)
(Singular und Plural)
The negation of the indefinite article (ein/eine/ein) is kein/keine/kein. For this, you just have to put a „k“ at the beginning of the declined form of ein/eine/ein.
Peter sieht ein Haus. □ Negation □ Peter sieht kein Haus.
(Peter sees a house. □ negation □ Peter does not see a house.)

(With examples, writing and hearing exercises, and German to English Glossary as applicable)

UNIT - II

Dativ (the dative)
(You are already familiar with verbs which require a direct accusative object in addition to the subject, which is in the nominative case. But there also some verbs which require a dative object besides the subject. To identify the dative object you ask “(To whom?”)

Der Plural (the plural)
There are many different forms of the plural in the German language. Principally, the gender and the ending of the noun determine the plural form. Then, you either attach a plural ending to the noun, change a vowel, or keep the noun as it is in the singular.

Das Personalpronomen (the personal pronoun)
The personal pronoun is a substitute for a noun. Its forms are determined by the case, number and gender of the noun which is to be replaced.

Die Formen des Personalpronomen im Nominativ
(The nominative forms of the personal pronoun):

Präpositionen (prepositions)
German prepositions are followed by an object, either in the accusative or the dative case. Some prepositions always take an accusative object, others always a dative object. But there are also prepositions which can be followed by both. In this case, the question “Where(to)?” (□ accusative) or “Where?” (□ dative) determines the case of the object.

Präpositionen mit Akkusativ und Dativ
(prepositions with accusative and dative)

1. Präpos
   - itonen mit Akkusativ (prepositions with accusative)
2. Präpos
   - itonen mit Dativ (prepositions with dative)
3. Präpos
   - itonen mit Akkusativ oder Dativ (prepositions with accusative or dative)

(With examples, writing and hearing exercises, and German to English Glossary as applicable)
Verbs are conjugated by attaching certain endings, depending on the person and number of the subject.

Trennbare und untrennbare Verben
(separable and inseparable verbs)
Verbs with prefixes are distinguished between separable and inseparable verbs. The prefix of an inseparable verb must never be separated from the stem. Here the stress is on the stem: be-kommen. The prefix of a separable verb gets separated from the stem when the verb is conjugated. In the infinitive, the stress is on the prefix: an-kommen

1. Trennbare Verben (separable verbs)
2. Untrennbare Verben (inseparable verbs)

Konjugation von Verben im Perfekt
(conjugation of verbs in present perfect)
The present perfect (Perfekt) describes something which happened in the past and is especially used in spoken German. It is formed with the present tense form of „haben“ or „sein“ and the past participle of the main verb.

1. Die Bildung des Partizips
(the formation of the past participle)
2. Die Bildung des Perfekts mit „haben“ und „sein“
(the formation of the present perfect with „haben“ and „sein“)

Modalverben (modal verbs)
A modal verb is rarely used as a main verb; instead, it usually modifies the main verb. While the main verb remains in the infinitive, the modal verb is conjugated. In German, there are 7 modal verbs:
können (can/be able), dürfen (may/be allowed), wollen (want), müssen (must/have to), sollen (shall), mögen (to like), möchten (wish/would like)

1. Konjugation der Modalverben
(conjugation of the modal verbs)
2. Stellung des Modalverbs im Satz
(position of the modal verb within a sentence)
(With examples, writing and hearing exercises, and German to English Glossary as applicable)

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

| CO 1 | Distinguish - definite and indefinite articles, declension of singular and plural nouns by adding certain endings to them to differentiate between subjects, objects and indirect objects and construct sentences of simple day to day usage. |
| CO 2 | Differentiate between nominative and accusative cases with transitive and intransitive verbs, and negation with Kein/e/er |
| CO 3 | Differentiate use of dative object besides the subject for some specific verbs and Apply the grammar principles of use of personal pronoun as a substitute for noun as per the case, number and gender of the noun. |
| CO 4 | Differentiate preposition forms when used exclusively in accusative or Dative forms or on combination of the two cases |
| CO 5 | Differentiate conjugation of verbs in present, present-perfect and past participle tenses, separable and inseparable verbs, application of conjugation of modal verbs and position of modal verb in a sentence. |

13 Hours
TEXTBOOKS:
2. Paul Coggle and Heiner Schenke, Teach Yourself German (a complete course in understanding, speaking and writing), Teach Yourself Books, Hodden & Stoughton Educational, UK, 2001
3. Langenscheidt German In 30 Days: Book + Cd Paperback, www.amazon.in. – 1 September 2011

REFERENCE BOOKS:
1. Deutsche Sprachlehre für Ausländer.
2. Themen Aktuell (Text and workbook).
3. Deutsch als Fremdsprache 1A.
4. Tangram Aktuell 1A/1B (Text and workbook).
5. Wherever required the Videos/Audios are also played in the class room sessions

MOOC Resources:
1. https://onlinecourses.nptel.ac.in/noc21_hs30/preview
   NPTEL-Swayam, German-I by Prof. Milind Brahme | IIT Madras
   powered by Sprachinstitut TREFFPUNKT Online

Course Articulation Matrix

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1: Low  2: Medium  3: High

Scheme of SEE Question Paper
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit – I & Unit – II and 1 full question from Unit – III.

SUSTAINABLE DEVELOPMENT GOALS

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Course Learning Objectives:
Sustainable Development Goals is a 2016 United Nations officially released Agendas for Sustainable approach environmental integrity, economic viability and a just society for present and future generations. It aims to provide the knowledge, skills, attitudes and values necessary to address sustainable development challenges. They address the global challenges we face, including poverty, inequality, climate change, environmental degradation, peace and justice. Learn more and take action. This SDG program is organized in such a way to be research-led, applied interdisciplinary program that considers sustainability in both developed and developing societies, and addresses critical global challenges put forth by UN.

UNIT – I

The origin, development and idea of the SDGs
History and origins of the Sustainable Development Goals. What are the SDGs? What are their aims, methodology and perspectives? How are they related to the Millennium Development Goals?
SDGs and Society: Ensuring resilience and primary needs in society
In-depth discussion and analysis of goals related to poverty, hunger, health & well-being and education

UNIT – II

SDGs and Society: Strengthening Institutions for Sustainability
In-depth discussion and analysis of goals related to gender equality, affordable and clean energy, sustainable cities & communities, and peace, justice & strong institutions
SDGs and the Economy: Shaping a Sustainable Economy
In-depth discussion and analysis of goals related to work & economic growth, industry, innovation & infrastructure, inequalities, responsible production & consumption

UNIT - III

SDGs and the Biosphere: Development within Planetary Boundaries
In-depth discussion and analysis of goals related to clean water, climate, life below water and life on land
Realizing the SDGs: Implementation through Global Partnerships
In-depth discussion and analysis of SDG 17 which aims to implement the SDGs through partnerships, finance, technology and the development of coherence between policies.

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

| CO 1 | Summarize the UN’s Sustainable Development Goals and how their aims, methodology and perspectives. |
| CO 2 | Analyze the major issues affecting sustainable development and how sustainable development can be achieved in practice. |
| CO 3 | Identify and apply methods for assessing the achievement/possibilities of sustainable development in Nitte gram panchayath. |
| CO 4 | Evaluate the implications of overuse of resources, population growth and economic growth and sustainability & Explore the challenges the society faces in making transition to renewable resource use |
| CO 5 | Create skills that will enable students to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development. |
TEXTBOOKS:

REFERENCE BOOKS:

MOOC Resources:

Course Articulation Matrix

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**SCHEMATIC CHART OF SEE QUESTION PAPER**

There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

***********

WEB TECHNOLOGIES

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**Course Learning Objectives (CLOs):**
At the end of the course student should be able to:
- Illustrate the Semantic Structure of HTML and CSS
- Compose forms and tables using HTML and CSS
- Design Client-Side programs using JavaScript and Server-Side programs using PHP
- Illustrate the Database connectivity using PHP
- Examine JavaScript frameworks such as jQuery

**UNIT - I**

Introduction to HTML- Html tags and simple HTML forms, web site structure, HTML table, Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colours and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.

**15 Hours**

**UNIT - II**

Client side Scripting: Introduction to JavaScript: JavaScript language – declaring variables, scope of variables functions, event handlers (on click, on submit etc.), Document Object Model, Form validations. Introduction to PHP: Declaring variables, data types, arrays, strings, operations, expressions, control structures, functions, Reading data from web form controls like Text Boxes, radio buttons, lists etc.,

**15 Hours**

**UNIT – III**

PHP Databases: Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, File Handling in PHP, PHP Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal Arrays, jQuery Introduction: What is jQuery, Adding jQuery in to your web pages, jQuery Syntax, jQuery Selectors, jQuery Events.

**9 Hours**

**Course Outcomes:**

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<td>Adapt HTML and CSS syntax and semantics to build web pages</td>
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<td>C8X52.2</td>
<td>Construct and visually format tables and forms using HTML and CSS</td>
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<td>C8X52.3</td>
<td>Experiment with the usage of Event handling and Form validation using JavaScript</td>
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Table: Mapping of COs to PI, POs and BTL

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Mapping Course Outcomes with Programme Outcomes:

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(L/1=Low30% -49%,M/2=Medium50% -69%,H/3=High>70%)

TEXTBOOK:

E RESOURCES:
1. nptel.ac.in/courses/106105084/11

SEE Question Paper Pattern:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabus& contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

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PROGRAMMING IN JAVA

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18CS8X77</th>
<th>CIE Marks</th>
<th>50</th>
</tr>
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</tr>
<tr>
<td>Total Hours</td>
<td>39</td>
<td>Credits</td>
<td>03</td>
</tr>
</tbody>
</table>
Course Learning Objectives:
This course will enable students to:
1. Learn fundamental features of object oriented language and JAVA programming constructs.
2. Develop and run simple Java programs using OOPS concepts of java
3. Create multi-threaded programs and event driven Graphical User Interface (GUI) programming using swing package.

UNIT – I

Introduction to Java: Java’s magic: The Byte code; Java Development Kit (JDK); the Java Buzzwords, Object-oriented programming; Simple Java programs. Data types, variables and arrays, Operators, Control Statements.

Classes, Inheritance: Classes fundamentals; Declaring objects; Call by value and Call by Reference, array of objects, Constructors, this keyword, and usage of static keyword.

UNIT – II

Inheritance: inheritance basics, using super, creating multi-level hierarchy, method Overriding, abstract classes, final classes.

Exception handling, packages and interfaces: Exception handling in Java, use of try, catch blocks, multiple catch blocks, finally block, use of throw and throws clauses, creating custom exceptions. Packages, Access Protection, Importing Packages, Interfaces. IO Streams for file handling.

Multi-Threaded Programming:
What are threads? How to make the classes threadable; Extending threads; Implementing runnable interface; creating multiple threads, join and is Alive methods of Thread class, Thread Synchronization; achieving thread synchronization among multiple threads. Thread priorities, methods to get and set thread priority

UNIT – III

Event Handling: Two event handling mechanisms; The delegation event model; Event classes; Sources of events; Event listener interfaces; Using the delegation event model;

Swings:
The origins of Swing; Two key Swing features; Components and Containers; The Swing Packages; A simple Swing Application; Create a Swing Applet; JLabel and ImageIcon; JTextField; The Swing Buttons; JTabbedPane; JScrollPane; JList; JComboBox; JTable.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Apply the object-oriented concepts to solve real world problems using JAVA programming features
2. Illustrate the basic constructs and object orients features of the Java language
3. Design a multi-threaded program using Java with exception handling
4. Develop Java programs that includes packages and interfaces and preform file operations in Java
5. Develop simple GUI interfaces for a computer program to interact with users, and to understand the event-based GUI handling principles using swings
**Graduate Attributes (GA)**
This course will map the following GA as per NBA:
1. Design/Development of Solutions
2. Problem Analysis
3. Modern tool usage

**TEXTBOOK:**

**REFERENCE BOOKS:**

**E-Books / Online Resources:**
1. Online course material by Oracle : [http://docs.oracle.com/javase/tutorial/index.html](http://docs.oracle.com/javase/tutorial/index.html)
2. [https://www.udemy.com/courses/search/?q=java&price=price-free&view=grid](https://www.udemy.com/courses/search/?q=java&price=price-free&view=grid)

**MOOC:**

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**DATA STRUCTURES AND ALGORITHMS**

<table>
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<th>Course Code</th>
<th>18CS8X78</th>
<th>CIE Marks</th>
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**Course Learning Objectives:**
This course will enable students to:
1. **Outline** the concepts of data structures, its types, structures and pointers.
2. **Understand** linear data structures, namely, stack, queue, singly linked list and doubly linked list.
3. **Analyze** nonlineardata structures, namely, binary tree and graphs.
4. **Analyze** the non-recursive and recursive algorithms and to represent Efficiency of these algorithms in terms of the standard Asymptotic notations.
5. **Explain** the various algorithm design techniques and apply them to solve various real world problems.
UNIT – I

INTRODUCTION:
Data Structure, Classification (Primitive and non-primitive), data structure operations.

POINTERS:
Definition and Concepts, Accessing variables through pointers, Arrays and pointers. Structures, pointers to structures.

LINEAR DATA STRUCTURES – STACKS:
Introduction and Definition, Representation of stack: Array and structure representation of stacks, Operations on stacks using C functions (Push(), Pop(), IsStackFull(), IsStackEmpty()).

LINEAR DATA STRUCTURES – QUEUES:
Introduction and Definition Representation of Queue: Array and Structure representation of queue, Operations on Ordinary Queue using C functions (Insert(), Remove(), IsQueueFull(), IsQueueEmpty())

UNIT – II

LINEAR DATA STRUCTURES - SINGLY LINKED LISTS:
Dynamic Memory allocation functions. Definition and concepts singly linked List: Representation of link list in memory, Operations on singly Linked List using C functions (Insert node at front, Remove a node from front, display singly linked list).

LINEAR DATA STRUCTURES - DOUBLY LINKED LISTS:
Doubly Linked List: Representation. (Operations not included).

NONLINEAR DATA STRUCTURES – BINARY TREES:
Binary Trees: Properties, Linked representation of Binary Tree, Binary Tree Traversals, Introduction to Binary Search Tree.

INTRODUCTION TO ALGORITHMS:
What is an Algorithm? Fundamentals of Algorithmic Problem Solving, understanding and representing graphs using adjacency matrix and linked list.

FUNDAMENTALS OF THE ALGORITHMS EFFICIENCY:
Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms.

UNIT – III

DECREASE & CONQUER:
Concept of Decrease and Conquer, Graph traversal algorithms - Depth First Search, Breadth First Search.

DYNAMIC PROGRAMMING:
Concept of Dynamic Programming, Computing a Binomial Coefficient.

GREEDY METHOD:
Concept of Greedy technique, Prims algorithm.

BACKTRACKING:
Concept of Backtracking technique, N-Queens problem.

15 Hours

UNIT – II

LINEAR DATA STRUCTURES - SINGLY LINKED LISTS:
Dynamic Memory allocation functions. Definition and concepts singly linked List: Representation of link list in memory, Operations on singly Linked List using C functions (Insert node at front, Remove a node from front, display singly linked list).

LINEAR DATA STRUCTURES - DOUBLY LINKED LISTS:
Doubly Linked List: Representation. (Operations not included).

NONLINEAR DATA STRUCTURES – BINARY TREES:
Binary Trees: Properties, Linked representation of Binary Tree, Binary Tree Traversals, Introduction to Binary Search Tree.

INTRODUCTION TO ALGORITHMS:
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DYNAMIC PROGRAMMING:
Concept of Dynamic Programming, Computing a Binomial Coefficient.

GREEDY METHOD:
Concept of Greedy technique, Prims algorithm.

BACKTRACKING:
Concept of Backtracking technique, N-Queens problem.

9 Hours
Course Outcomes:
1. Acquire the fundamental knowledge of various types of data structures and pointers using that knowledge, analyze and design the programs using pointers.
2. Apply the fundamental programming knowledge of data structures to analyze and design linear data structures, namely, stack, queue, singly linked list and doubly linked list and use them for solving problems.
3. Implement and apply the concept of binary trees and graph data structures and also understand their traversals.
4. Analyze non-recursive or recursive algorithm and to represent in terms of standard Asymptotic notations.
5. Apply Divide and Conquer, Decrease and Conquer, Dynamic programming, Greedy, and Backtracking algorithm design techniques to solve real time problems.

TEXTBOOKS:

REFERENCE BOOKS:

MOOC:
1. Introduction to Data Structures by edx, URL: https://www.edx.org/course/
2. Advance Data Structures by MIT OCW, URL: https://www.mooclab.club/
4. http://nptel.ac.in/courses/106101060/

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ELECTRIC VEHICLE TECHNOLOGY

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Eligible Students: For all engineering stream except E&E Engineering

Course Learning Objectives:
1. To Understand the fundamental laws and vehicle mechanics.
2. To Understand working of Electric Vehicles and recent trends.
3. Ability to analyze different power converter topology used for electric vehicle application.
4. Ability to develop the electric propulsion unit and its control for application of electric vehicles.
UNIT – I


**Electric and Hybrid Electric Vehicles:** Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains. 14 Hours

UNIT – II

**Energy storage for EV and HEV:** Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Supercapacitors.

**Electric Propulsion:**
EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives. 16 Hours

UNIT – III

**Design of Electric and Hybrid Electric Vehicles:** Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design. 9 Hours

**Course Outcomes:**
At the end of the course student will be able to
1. Explain the roadway fundamentals, laws of motion, vehicle mechanics and propulsion system design.
2. Explain the working of electric vehicles and hybrid electric vehicles in recent trends.
4. Analyze DC and AC drive topologies used for electric vehicle application.
5. Develop the electric propulsion unit and its control for application of electric vehicles.

<table>
<thead>
<tr>
<th>Course Outcomes Mapping with Program Outcomes &amp; PSO</th>
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<tbody>
<tr>
<td>Program Outcomes</td>
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<tr>
<td>------------------</td>
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<tr>
<td>18EE8X .1</td>
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1: Low 2: Medium 3: High
SEE QUESTION PAPER PATTERN:

- There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit - I & Unit – II and 1 full question from Unit – III.

TEXTBOOKS:


REFERENCE BOOKS:


E-Books / MOOC:

1. Introduction to Mechanics | Coursera
2. NPTEL: Electrical Engineering - Introduction to Hybrid and Electric Vehicles
3. Electric Vehicles - Part 1 - Course (nptel.ac.in)
4. Hybrid Vehicles (edX) | MOOC List (mooc-list.com)
5. NPTEL: Electrical Engineering - Introduction to Hybrid and Electric Vehicles

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Course Learning Objectives:

This Course will enable students to:
1. Learn the IoT Definitions, Design aspects
2. Identify the IoT hardware and software requirements
3. Describe IoT logical and physical design concepts
4. Implement Arduino based IoT Projects
5. Implement Raspberry Pi based IoT Projects

UNIT – I

Introduction
Introduction to IoT : Definition and characteristics, Physical design, Logical design, Enabling technologies, Levels and deployment templates, Examples: Domain specific IoTs, IoT Design and System Engineering, Discuss IoT Requirements, Hardware & Software;
UNIT – II

Design Concepts:

IoT Logical Design:
Data types, Data structures, Control flow, Functions, Modules, Packages, File Handling, Date and time operation, Classes, Python packages of IoT, IoT Physical Design, Basic building blocks, Raspberry Pi, Linux on Raspberry Pi, Interfaces, Programming on Raspberry Pi with Python, Arduino Based IoT Project Implementation, Arduino for Project development, Internet enabled Arduino powered garage door opener, Irrigation control system, Light controller Message, controller and cloud Services
(Text Book-1: Chapter 4,5,6 ,7)

UNIT – III

Raspberry Pi based IoT Project Implementation:
Raspberry Pi for Project Development: Raspberry Pi platform, GPIO, Establishment and setting, of Raspberry Pi software, LAMP project, Home temperature, monitoring system, Webcam and Raspberry Pi camera project (Text Book-1: Chapter 10,11,12, 13)

Course Outcomes:

At the end of the course the student will be able to:
1. Acquire the fundamental knowledge of IoT Definitions, Design aspects
2. Identify the IoT hardware and software requirements
3. Design IoT logical and physical architecture
4. Implement Arduino based IoT Projects
5. Implement Raspberry Pi based IoT Projects

TEXTBOOKS:

REFERENCE BOOKS:
1. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs
3. Jeeva Jose,”Internet of Things”, Khanna Publishing House, Delhi
4. Adrian McEwen,”Designing the Internet of Things”, Wiley
6. Cuno Pfister, “Getting Started with the Internet of Things”, O Reilly Media
E-Books / Online Resources:
2. Object-Oriented Modelling and Design with UML, James R Rumbaugh, Michael R. Blaha Pearson Education, 21-Nov-2011

MOOC: