NITTE EDUCATION TRUST | **NMAM INSTITUTE OF TECHNOLOGY**

College Calendar 2023-24

Department of Robotics & Artificial Intelligence Engineering

Syllabus of 3rd Year

NITTE | **NMAM INSTITUTE OF TECHNOLOGY**

EDUCATION TRUST

(An Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi)

Nitte - 574110, Karnataka, India

ISO 9001: 2015 Certified, Accredited by NAAC with 'A' Grade

V & VI SEMESTER
Department of Robotics & Artificial Intelligence Engineering

College Calendar 2023-24

मातेव रक्षति पितेव हिते नियुङ्क्ते
कान्तेव चापि रमयत्यपनीय खेदम् ।
लक्ष्मीं तनोति वितनोति च दिक्षु कीर्तिं
किं किं न साधयति कल्पलतेव विद्या ॥

ಮಾತೇವ ರಕ್ಷತಿ ಪಿತೇವ ಹಿತೇ ನಿಯುಂಕ್ತೇ
ಕಾಂತೇವ ಚಾಪಿ ರಮಯತ್ಯಪನೀಯ ಖೇದಮ್ ।
ಲಕ್ಷ್ಮೀಂ ತನೋತಿ ವಿತನೋತಿ ಚ ದಿಕ್ಷು ಕೀರ್ತಿಂ
ಕಿಂ ಕಿಂ ನ ಸಾಧಯತಿ ಕಲ್ಪಲತೇವ ವಿದ್ಯಾ ॥

ತಾಯಿಯಂತೆ ರಕ್ಷಣೆಯನ್ನಿತ್ತು, ತಂದೆಯಂತೆ ಸನ್ಮಾರ್ಗದಲ್ಲಿ ತೊಡಗಿಸಿ ಪತ್ನಿಯಂತೆ ದುಃಖವನ್ನು ದೂರಮಾಡಿ ಮನಕ್ಕೆ ಮುದಕೊಡುತ್ತಾ, ಸಂಪತ್ತನ್ನು ವರ್ಧಿಸಿ ದಶದಿಕ್ಕುಗಳಲ್ಲಿ ಕೀರ್ತಿಯನ್ನು ಪಸರಿಸುವ 'ವಿದ್ಯೆ', ಕಲ್ಪಲತೆಯಂತೆ ನಾವು ಬಯಸಿದ್ದನ್ನು ಕೊಡುತ್ತಾಳೆ.

विद्या माता की तरह पालन करती है, बाप के तरह हितकर मार्ग में ही ले लेता है। पत्नी की तरह हमारा दुःख दूर करता है। मन को संतोष देता है, धन देती है, दिशओं में कीर्ति फैलाती है। कल्पवल्ली 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.

NITTE EDUCATION TRUST | **NMAM INSTITUTE OF TECHNOLOGY**

(An Autonomous Institution affiliated to VTU, Belgavi)
NITTE-574110, Karkala Taluk, Udupi District, Karnataka, India
ISO 9001:2015 Certified, Accredited by NAAC with "A" Grade

COLLEGE CALENDAR
2023-24
(V & VI Semester)

NITTE EDUCATION TRUST | **NMAM INSTITUTE OF TECHNOLOGY**

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EDUCATION TRUST

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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

NITTE EDUCATION TRUST | **NMAM INSTITUTE OF TECHNOLOGY**

Sl.No.	Name of the Faculty	Designation
1.	Dr. N. Niranjan Chiplunkar	Principal
2.	Mr. Yogeesh Hegde	Director(CM&D)
3.	Dr. Shrinivasa Rao B. R.	Vice Principal/Controller of Examinations/Professor
4.	Dr. I. Ramesh Mithanthaya	Vice Principal / Dean (Academic)/Professor
5.	Dr. Sudesh Bekal	Dean (R&D)/Professor
6.	Dr. Rajesh Shetty K.	Dean (Admissions)/Professor
7.	Dr. Rekha Bhandarkar	Deputy Registrar of Nitte Off-campus Centre, Nitte (DU)
8.	Dr. Subrahmanya Bhat K	Deputy COE of Nitte Off-campus Centre, Nitte (DU)
9.	Dr. Nagesh Prabhu	Director(Curriculum Development) Nitte (DU)
10.	Dr. Srinath Shetty K.	Resident Engineer/Professor
11.	Dr. Narasimha Bailkeri	Dean(Student Welfare)/Professor
12.	Dr. Rajalakshmi Samaga BL	PG Coordinator/Professor

HEADS OF DEPARTMENTS

1.	Dr. Arun Kumar Bhat	HoD, Civil Engg.
2.	Dr. Jyothi Shetty	HoD, Comp. Science & Engg
3.	Dr. Ashwini B	HoD, Information Science & Engg
4.	Dr. Ujwal P	HoD, Biotechnology
5.	Dr. KVSSSS Sairam	HoD, E&C Engg.
6.	Dr. Suryanarayana K	HoD, E&E Engg.
7.	Dr. Muralidhara	HoD, Robotics & Artificial Intelligence
8.	Dr. Kumudakshi	HoD, Mathematics
9.	Dr. Shobha R. Prabhu	HoD, Physics
10.	Dr. Shivaprasad Shetty M.	HoD, Chemistry
11.	Dr. Mamatha Balipa	HoD, MCA
12.	Dr. Vishwanatha	HoD, Humanities

13.	Dr. Udaya Kumar K Shenoy	HoD, Computer & Communication Engg
14.	Dr. Sharada Uday Shenoy	HoD, Artificial Intelligence & Machine Learning
15.	Dr. Srinivas Pai P	HoD, Mechanical Engg
16.	Dr. Venugopala PS	HoD, Artificial Intelligence & Data Science
17.	Mr. Bharath G Kumar	Head, Training & Placement Cell

INCHARGE OF INSTITUTION'S RESPONSIBILITIES

1.	Dr. Shashikanth Karinka	Co-ordinator MoUs
2.	Dr. Gururaj Upadhyaya	Workshop Suptd
3.	Dr. Joy Elvine Martis	1st year Coordinator
4.	Dr. Jnaneshwar Pai Maroor	Co-ordinator Alumni
5.	Dr. Venkatesh Kamath	Assistant CoE
6.	Dr. Janardhan Nayak	Co-ordinator – Red Cross Unit
7.	Mr. Srinivas Nekkar	NCC Officer
8.	Mr. Krishnaraja Joisa	Public Relation Officer
9.	Mr. K. Sathish Nayak	Digital Media Executive
10.	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. Ankith S Kumar | Counsellor |

DEPARTMENT OF MATHEMATICS

1.	Dr. Shashirekha B. Rai	Professor
2.	Dr. Kumudakshi	Asso. Professor/ HoD
3.	Dr. Sharad M. Hegde	Asst. Professor Gd III
4.	Dr. Vasanth K.R	Asst. Professor Gd III
5.	Dr. Ashwini Kumari	Asst. Professor Gd III
6.	Dr. Chaithra K.	Asst. Professor Gd III

7.	Dr. Prashanthi K S	Asst. Professor Gd III
8.	Dr. Girija K P	Asst. Professor Gd III
9.	Dr. Ganesh Kumar K	Asst. Professor Gd III
10.	Mrs. Ambika N.	Asst. Professor Gd I
11.	Mrs. Vinaya Acharya	Asst. Professor Gd I
12.	Mrs. Anitha D. Bayar	Asst. Professor
13.	Mrs. Bhavya K.	Asst. Professor
14.	Mrs. Bhavya. D.	Asst. Professor
15.	Mrs. Sharmila	Asst. Professor
16.	Mrs. Anjana Pai K	Asst. Professor
17.	Mrs. Soumya	Asst. Professor
18.	Mrs. Smitha G. V.	Asst. Professor

DEPARTMENT OF PHYSICS

1.	Dr. Manjunath K. B.	Professor
2.	Dr. Shobha R. Prabhu	Asso. Professor / HoD
3.	Dr. Sathyajith	Asso. Professor
4.	Dr. Raghavendra Bairy	Asso. Professor
5.	Dr. Nagaraja B.S.	Asst. Professor Gd III
6.	Dr. Shyam Prasad . K.	Asst. Professor Gd III
7.	Dr. Saritha Suvarna	Asst. Professor Gd III

DEPARTMENT OF CHEMISTRY

1.	Dr. Janardhana Nayak	Professor
2.	Dr. Ramesh Bhat	Asso. Professor
3.	Dr. Shivaprasad Shetty M.	Asso. Prof/HoD
4.	Dr. Aarti S. Bhat	Asst. Professor Gd III
5.	Dr. Subrahmanya Ishwar Bhat	Asst. Professor Gd III
6.	Dr. Sarvajith MS	Asst. Professor Gd III
7.	Dr. Ranjitha	Asst. Professor Gd III

DEPARTMENT OF HUMANITIES

1. Dr. Ramakrishna B.   Professor
2. Mrs. Rashmi D. Hegde   Asso. Professor
3. Dr. Vishwanatha   Asso. Professor /HoD
4. Dr. Jnaneshwar Pai Maroor   Asst. Professor Gd III
5. Dr. Joy Elvine Martis   Asst. Professor Gd III
6. Mrs. Shyla D Mendonca   Asst. Professor Gd II
7. Ms. Sonia Lobo   Asst. Professor Gd I
8. Ms. Akshatha Kumari J Shetty   Asst. Professor Gd I
9. Mr. Srinivas Nekkar   Asst. Professor
10. Mrs. Sudeeksha S. Pai   Asst. Professor
11. Mrs. Shwetha   Asst. Professor

OFFICE SECTION HEADS

1. Mr. Keshava Mugeraya   Sr. Suptd, Academic Section/
                                         Purchase In -Charge
2. Mrs. Suneetha R. Shetty   Sr. Suptd, Administrative Section
3. Mr. Suresh Achar   Sr. Suptd, Stores
4. Mrs. Jayashree   Sr. Programmer, Office Automation Cell
5. Mrs. Shailaja V. Shetty   Suptd, Accounts Section
6. Dr. Preetham Shetty KV   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
5. Mr. Clive Nolan Mascarenhas   Football Coach
6. Mr. Rajesh Acharya   Cricket 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. Manjunatha Suvarna   Hostel Manager, Gents Main Hostel
3. Mr. Rajesh Ballal   Manager, Gents PG Hostel
4. Mrs. Gayathri Kamath   Manager, Ladies PG Hostel
5. Mrs. Chethana Sharma   Manager, Ladies Main Hostel
6. Mrs. Hema S. Hegde   Superintendent, Hostel Office

REGULATIONS
2023-24
(Applicable for admission batch 2021-22 onwards)

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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	Main semester (odd, even) each 19 Weeks; Supplementary Semester 8 Weeks
3. Academic Activities	Main Semester
(Weeks):	Registration of Courses & Course Work (16.0) Examination Preparation and Examination (3.0) Total (19) Supplementary Semester

	Registration of Courses & Course Work (5.0) Examination Preparation and Examination (3.0) Total (8) Declaration of results: 2 weeks from the date of last examination Inter- Semester Recess: After each Main Semester (2) Total Vacation: 10 weeks (for those who do not register for supplementary semester) and 4 weeks (for those who register for supplementary semester)

(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:

i)	Biotechnology Engineering	(BT)
ii)	Civil Engineering	(CV)
iii)	Computer Science & Engineering	(CS)
iv)	Electronics & Communications Engineering	(EC)
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

A student must register, as advised by Faculty Advisor, between a

minimum of 15 credits and up to a Maximum of 25 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 -

i) satisfied all the academic requirements to continue with the programme of studies without termination

ii) cleared all Institute, hostel and library dues and fines, if any, of the previous semester

iii) paid all required advance payments of the Institute and the hostel for the current semester

iv) 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 (=20) or to be within the limits of minimum (=15) and maximum (=25) 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:**

No.	Course Category	Credit Range
1.	Basic Science Courses	20-25
2.	Engineering Science Courses	18-22
3.	Humanity, Social Science and Management	8-12
4.	Ability Enhancement Courses	10-14
5.	Professional Core Courses (PCC)	40-45
6.	Professional Elective Courses (PEC)	8-12
7.	Open Elective Courses (OE)	8-12
8.	Skill Courses (Project Work / Internship / Seminar)	28-36
9.	Mandatory courses	2
Note: **Student can register between 15 to 25 credits per semester** **Total Credits to be earned : 160**		

5.2   The Department Undergraduate Committee (DUGC) will discuss and recommend the exact credits offered for the programme for the above components, 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 160.**
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, 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 7th 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 6th 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 6th & 7th 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 (160 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

Evaluation Method	Passing Standard
Sessional (CIE)	Score: ≥40% (≥20 marks)
Terminal (SEE)	Score: ≥40% (≥20 marks)

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

Level	Out Standing	Excellent	Very Good	Good	Average	Poor	Fail
Grade	S	A	B	C	D	E	F
Grade Points	10	09	08	07	06	04	00
Score (Marks) Range(%)	≥ 90	< 90 - ≥80	< 80- ≥70	< 70- ≥60	< 60 - ≥50	< 50 - ≥40	< 40

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 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) 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.

b) 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.

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

CGPA is computed as follows:

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

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.

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 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 160 (120 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)

Grade Point	Percentage of Marks	Class
≥ 7.75	≥ 70%	Distinction
≥ 6.75	≥ 60%	First Class
< 6.75	< 60%	Second Class

Percentage = (GPA - 0.75) x 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 (160 credits for regular students registered for 4 year degree programmes & 120 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-certificates 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 ≥ 5.00 at the end of the Programme

(a) Students, who have completed all the courses of the Programme but not having a CGPA ≥ 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 ≥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 ≥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

Applicable to	Types of scholarship	Method	Website
For SC/ST Students	Income : Below Rs.2,50,000/-	Online application	SSP
	Income : Above Rs.2,50,000/- to Rs.10,00,000/-		
For Others	Category I : Income Below Rs.2,50,000/-	Online application	
	Category 2A, 3A, 3B Income Below Rs.1,00,000/-	Online application	
	GSB & Brahmins EWS Certificate upto Rs.8,00,000/-	Online application	
	Minority students Income Below Rs.2,50,000/-	Online application	NSP & SSP
Parents must have Beedi Id. Card	Beedi Scholarship	Online application	scholarships.gov.in or nsp.gov.in

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

ROBOTICS & ARTIFICIAL INTELLIGENCE ENGINEERING

V & VI SEMESTER

With

Scheme of Teaching

& Examination

DEPARTMENT OF ROBOTICS AND AI FACULTY
UNDERGRADUATE PROGRAMME

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Mr. Nirmit Jain M. Tech Research Assistant	**Mrs. Sandhya** MTech Research Assistant

B. Tech. in Robotics & Artificial Intelligence Engineering

Vision:

To produce Robotics and Artificial Intelligence (AI) engineers of the highest quality who are professionally competent and highly qualified to suit the needs of industries and organizations by promoting excellence in teaching, learning and research.

Mission:

The Dept. of Robotics & Artificial Intelligence Engineering is committed to

- Provide high quality education to the students, to fulfill the requirements of a 'Global Engineer'
- Constantly strive to improve the teaching-learning methods, in order to deliver good academic programs
- Respond to the fast evolving scientific and technological challenges in a highly competitive world
- Inculcate, ethics, integrity, honesty, credibility, social and environmental consciousness

Program Educational Objectives (PEOs):

PEO 1: Demonstrate technical competence in Robotics and Artificial Intelligence and their applications

PEO 2: Design hardware solutions for robotics application and software solutions for implementation of Artificial Intelligence in Robotics

PEO 3: Pursue higher studies to carry out research and development in the area of Robotics and Artificial Intelligence

PEO 4: Engage in lifelong learning, communicate effectively and exhibit leadership skills and demonstrate sensitivity towards professional ethics.

Program Outcomes (POs):

Engineering Graduates will be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex

engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: 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.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: 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.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: 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 (PSOs):

PSO 1: Design the robotic structure for different applications and implementation of control circuits to achieve the desired automation through analytical, logical and problem-solving skills.

PSO 2: Develop software systems for the application of artificial intelligence in robotics.

PSO 3: Apply the knowledge of robotics and Artificial intelligence in the areas of industrial robotics, service robots, exoskeletons, surgical robots, delivery vehicles, autonomous vehicles, and crewless micro aerial vehicles.

NMAM INSTITUTE OF TECHNOLOGY, NITTE
B.E. in ROBOTICS AND ARTIFICIAL INTELLIGENCE (RI)
Scheme of Teaching and Examinations 2021
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year (2021-22)

V SEMESTER

Sl.No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credit
					Theory Lecture	Tutorial	Practical/ Drawing	Self-Study Componen	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	21RI501	Introduction to Artificial Intelligence and Machine Learning	RI	3	0	0	0	03	50	50	100	3
2	IPCC	21RI502	Micro Aerial Vehicles	RI	3	0	2	0	03	50	50	100	4
3	PCC	21RI503	Kinematics and Dynamics of Robot	RI	3	0	0	0	03	50	50	100	3
4	PCC	21RI504	Control Engineering	RI	3	0	0	0	03	50	50	100	3
5	Laboratory	21RI505	AI and ML Lab	RI	0	0	2	0	03	50	50	100	1
6	AEC	21HU511	Research Methodology & Intellectual property rights	RI	2	0	0	0	03	50	50	100	2
7	HSMC	21RI507	Environmental Studies	RI	1	0	0	0	03	50	50	100	1
8	AEC	21RI51x	Ability Enhancement Courses-V	RI	1	0	0	0	03	50	50	100	1
			TOTAL		16	0	4	0	24	400	400	800	18

Note: BSC: Basic Science Course, **PCC:** Professional Core Course, **HSMC:** Humanity and Social Science & Management Courses, AEC –Ability Enhancement Courses. **INT –** Internship, IPCC: Integrated Professional Core Course.

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). CIE for Theory is for 50 marks and CIE for Lab component is 50marks. The final CIE for these IPCC courses is for 50 marks with 60% weightage of theory & 40% weightage of lab component CIE.

Non – credit mandatory courses (NCMC):
National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

Physical Education (Sport & Athletics)/YOGA & NSS will be offered both in Vth & VIth semester with CIE 50 marks and SEE 50 marks with 0 credits. Students have to complete any one either in Vth or VIth semester.

Ability Enhancement Course-V	
Subject Code	Title
21RIA51	CNC Technologies
21RIA52	Start-up Policy and General Compliances
21RIA53	PLC Control of Hydraulic and Pneumatic Circuits
21RIA54	Engineering Economics
21RIA55	Data Acquisition and Measurements

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VI SEMESTER

Sl.No	Course and Course Code		Course Title	Teaching Department	Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	Credits
					L	T	P	S					
1	HSMC	21RI601	Technological Innovation Management and Entrepreneurship	RI	3	0	0	0	03	50	50	100	3
2	IPCC	21RI602	Drive Systems for Robot	RI	3	0	2	0	03	50	50	100	4
3	PCC	21RI603	Neural Networks and Deep Learning	RI	3	0	0	0	03	50	50	100	3
4	PEC	21RI64x	Professional Elective Course-I	RI	3	0	0	0	03	50	50	100	3
5	OEC	21RI6xx	Open Elective Course-I	RI	3	0	0	0	03	50	50	100	3
6	PCC	21RI606	Control Engineering Lab	RI	0	0	2	0	03	50	50	100	1
7	MP	21RI607	Mini Project	RI	0	0	4	0	04	50	--	50	2
8	INT	21RI608	Innovation/Entrepreneurship /Societal Internship	RI	Completed 4 weeks of Internship during the intervening period of IV and V semesters.					100	---	100	3
			TOTAL		15	00	08	00	22	450	300	750	22

Note: **BSC**: Basic Science Course, **PCC**: Professional Core Course, **HSMC**: Humanity and Social Science & Management Courses, **PEC**: Professional Elective Courses, **OEC** –Open Elective Course, **AEC** –Ability Enhancement Courses. **MP** –Mini Project, **IPCC**: Integrated Professional Core Course

L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). CIE for Theory is for 50 marks and CIE for Lab component is 50marks. The final CIE for these IPCC courses is for 50 marks with 60% weightage of theory & 40% weightage of lab component CIE.

Professional Elective Courses(PEC):

A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum.

Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum students' strength for offering professional electives is 10.

Non – credit mandatory courses (NCMC):
National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:
Physical Education (Sport & Athletics)/YOGA & NSS will be offered both in Vth & VIth semester with CIE 50 marks and SEE 50 marks with 0 credits. Students have to complete any one either in Vth or VIth semester.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.

Selection of an open elective shall **not be allowed** if,
(i) The candidate has studied the same course during the previous semesters of the program.
(ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
(iii) A similar course, under any category, is prescribed in the higher semesters of the program.
In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business (MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by submitting a copy of the syllabus along with the details of expertise available to teach the same in the college.
The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.
CIE procedure for Mini-project:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.
The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
No SEE component for Mini-Project.

VII semester Class work and Research Internship /Industry Internship (21INT82)
Swapping Facility
Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**
(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportUNITy for internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship.

Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The internship can also be rural internship.

The mandatory Research internship /Industry internship is for 24 weeks. The 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 and shall have to complete during the subsequent University examination after satisfying the internship requirements.

INT21INT82Research Internship/ Industry Internship/Rural Internship

Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

Professional Elective Courses-I		Open Elective Courses-I	
Subject Code	Title	Subject Code	Title
21RI641	PLC and SCADA	21RI651	Wheeled mobile Robot
21RI642	Computer Vision		
21RI643	Introduction to MATLab Programming		
21RI644	Autonomous Vehicles		
21RI645	Virtual Instrumentation		

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Code	21RI501	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

This Course will enable students to

- Understand the basics of Artificial Intelligence. Explain what is involved in learning models from data.
- Familiarize with the concepts of informed and uninformed search strategies and Heuristic functions
- Demonstrate the application of linear regression and logistic regression for real world problems. Explain the design and implement algorithms for supervised learning
- Explain construct basic unsupervised learning algorithms
- To explain the concepts of Uncertainity, probability, Bayes rule and interference using full joint distributions

UNIT – I

Introduction to Artificial Intelligence: History, Need, applications, advantages and limitations. What is Artificial Intelligence? Why we need ML? Difference between AI and ML, Difference between ML and DL, Different ML Algorithms

Foundations for ML: Fundamentals and application of machine learning, Understanding Data, Types of machine learning: Supervised, Unsupervised, Reinforcement Learning, Theory of learning: feasibility of learning, error and noise, training versus testing, theory of generalization, bias and variance, learning curve.

Intelligent Agents: Agents and Environment, Structure of Agents

Solving problems: Problem solving agents, uninformed search strategies, informed search strategies, Heuristic functions   **15 Hours**

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT – II

Probabilistic reasoning: Representing knowledge in uncertain domain, Semantics of Bayesian networks, Relational and first order probability models

Learning from examples: Forms of learning, Learning Decision trees, the theory of learning, Regression and classification with linear models, Non parametric models.   **15 Hours**

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT – III

Machine Learning: Introduction to Artificial neural network, Network architectures, Learning

Theory of learning: feasibility of learning, error and noise, training versus testing, theory of generalization, bias and variance, learning curve

Clustering: Introduction, K-means, Hierarchical clustering

Support Vector Machines and Kernel methods - Introduction, statistical learning theory, soft vs hard SVMs, multiclass SVMs, SVMs for regression, linear vs nonlinear SVMs, Kernel tricks, implementing soft-SVM with kernels, optimal hyperplane for linearly separable and non-separable patterns, VC dimension

of SVMs.	**9 Hours**
Pedagogy	Chalk and talk, Power point presentation, Videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to:
1. Explain about Artificial Intelligence, identify its relation with Machine learning, Deep Learning and foundation of ML
2. Describe the working of Linear Regression models and Multiple Linear Regression models
3. Explain Probability theory and Ensembles methods
4. Explain decision tree modelling and different clustering methods
5. Know the fundamental concept of neural network techniques and learning algorithms

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

MSE I	20 Marks
MSE II	20 Marks
Task	10 Marks
Total	50 Marks

Semester End Examination:

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**.

Suggested Learning Resources:

TEXTBOOKS:
1. Stuart Russel and Peter Norvig , "Artificial Intelligence A Modern Approach", Pearson 3 rd Edition , 2016
2. Tom. M. Mitche, "Machine Learning", McGraw Higher Ed, 1st edition 2013.
3. Understanding Machine Learning – from Theory to Algorithms by Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 2014,ISBN978-1-107-05713-5 Hardback
4. Neural Networks – A comprehensive Foundation, Simon Haykin, Pearson Prentice Hall, Second Edition, 2005, ISBN 81 – 7808 -300 – 0

REFERENCE BOOKS:
1. DAN W PATTERSON," Introduction to Artificial Intelligence and Expert Systems", PEARSON, 1st edition 2015.
2. Elaine Rich, "Artificial Intelligence", Mc Graw Hill 3rd Edition, 2017.
3. Er. Rajiv Chopra, "Artificial Intelligence – A practical approach", Chand publication, 1st edition 2012

Web links and Video Lectures (e-Resources):
1. https://onlinecourses.nptel.ac.in/noc21_cs42/preview
2. https://nptel.ac.in/courses/106/105/106105152/
3. https://nptel.ac.in/courses/106/105/106105079/
4. https://nptel.ac.in/courses/112/103/112103280/
5. https://nptel.ac.in/courses/106/105/106105078/
6. https://onlinecourses.nptel.ac.in/noc21_ge20/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
- http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/index.php

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI501 / Introduction to Artificial Intelligence and ML															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI501.1	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2
C-21RI501.2	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2
C-21RI501.3	2	2	2	1	2	-	-	-	-	-	-	2	2	2	2
C-21RI501.4	2	2	2	1	2	-	-	-	-	-	-	2	2	2	2
C-21RI501.5	2	2	2	1	2	-	-	-	-	-	-	2	2	2	2

1: 1ow   2: Medium   3: High

MICRO AERIAL VEHICLES

Course Code	21RI502	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	04	Exam Hours	3

Course Learning Objectives:
  This Course will enable students to:
  • Comprehend the basic aviation history and UAV systems.
  • Acquire the knowledge of basic aerodynamics and performance.
  • Understand the stability and control air vehicles
  • Understand the propulsion, loads and structures.
  • Develop and test the remote controlled, autonomous aerial vehicles

UNIT – I

Introduction Aviation History and Overview of UAV systems, Classes and Missions of UAVs, Definitions and Terminology, UAV fundamentals, Examples of UAV systems-very small, small, Medium and Large UAV
The Air Vehicle
Basic Aerodynamics:
Basic Aerodynamics equations, Aircraft polar, the real wing and Airplane, Induced drag, the boundary layer, Flapping wings, Total Air-Vehicle Drag
Performance:
Overview, climbing flight, Range and Endurance – for propeller-driven aircraft, range- a jet-driven aircraft, Guiding Flight.   **15 Hours**

Pedagogy	Chalk and talk, Power point presentation,

UNIT - II

Stability and Control
Overview, Stability, longitudinal, lateral, dynamic stability, Aerodynamics control, pitch control, lateral control, Autopilots, sensor, controller, actuator, airframe control, inner and outer loops, Flight-Control

Classification, Overall Modes of Operation, Sensors Supporting the Autopilot.
Propulsion Overview, Thrust Generation, Powered Lift, Sources of Power, The Two-Cycle Engine, The Rotary Engine, The Gas Turbine, Electric Motors, and Sources of Electrical Power. Loads and Structures Loads, Dynamic Loads, Materials, Sandwich Construction, Skin or Reinforcing Materials, Resin Materials, Core Materials, Construction Techniques. **15 Hours**

Pedagogy	Chalk and talk, Power point presentation,

UNIT - III

Mission Planning and Control: Air Vehicle and Payload Control, Reconnaissance/Surveillance Payloads, Weapon Payloads, Other Payloads, Data-Link Functions and Attributes, Data-Link Margin, Data-Rate Reduction, Launch Systems, Recovery Systems, Launch and Recovery Trade-offs

09 Hours

List of Laboratory Experiments:

1. Experiments on BLDC Motor driving and speed control
2. LIDAR for linear distance Measurement
3. IMU Sensor for force, acceleration and angle measurement
4. Speed vs Force characteristics of a BLDC driven propeller using Load Cell sensor.
5. Experiments on Thrust force control of a propeller driven by BLDC motor
6. Roll and Pitch Control of a drone driven by BLDC Motor controlled propeller mounted on a knuckle joint/Ball Joint using IMU Sensor
7. Height and Yaw control of a quadcopter driven by BLDC Motor controlled propeller
8. PID controlled pitch angle for two BLDC Controlled propellers
9. Experiments on height measurement of a drone using LIDAR sensor.

Course outcome (Course Skill Set)

At the end of the course student will be able to

1. Explain the basics of aerodynamics performance and apply the basic concepts of UAV systems and experimentally study the integration of drones.
2. Explain the stability and control required for UAV and Select the propulsion system, materials for structures.
3. Develop and test remote controlled autonomous aerial vehicles. Experimental study on remote controlled and autonomous UAV.
4. Design air vehicles for different payloads and design standards. Experimental study on autonomous and remote-controlled Vertical Take-off and Landing UAV
5. Develop and test rotary wing aerial vehicles. Experimental study on Unmanned aerial vehicles and fixed wing UAV

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). CIE for Theory is for 50 marks and CIE for Lab component is 50marks. The final CIE for these IPCC courses is for 50 marks with 60% weightage of theory & 40% weightage of lab component CIE.

Theory Component		Lab Component	
MSE I	20 Marks	Conduction of Experiments	10 Marks
MSE II	20 Marks	Lab Record	10 Marks
Task-I	5 Marks	Viva Voce	10 Marks
Task-II	5 Marks	Lab MSE	20 Marks
Total	50 Marks	Total	50 Marks

Semester End Examination:

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**.

Suggested Learning Resources:
BOOKS:
1. Paul Gerin Fahlstrom, Thomas James Gleason, Introduction to UAV Systems, Wiley Publication, 4th Edition,2012.
2. Landen Rosen, Unmanned Aerial Vehicle, Alpha Editions
3. Unmanned Aerial Vehicles: DOD's Acquisition, Alpha Editions
4. Valavanis, Kimon P , Unmanned Aerial Vehicles , Springer, 2011
5. Valavanis, K., Vachtsevanos, George J , Handbook of Unmanned Aerial Vehicles , Springer, 2015.

Web links and Video Lectures (e-Resources):
1. https://onlinecourses.nptel.ac.in/noc22_me38/preview

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI502 / Aerial Vehicles															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI502.1	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
C-21RI502.2	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
C-21RI502.3	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
C-21RI502.4	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
C-21RI502.5	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2

1: 1ow   2: Medium   3: High

KINEMATICS AND DYNAMICS OF ROBOT

Course Code	21RI503	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(2:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:
* To study the direct kinematics solutions for the different robot configurations
* To study the Inverse kinematics solutions for the different robot configurations
* To study the Jacobian Matrix for the different robot configurations
* To identify the singular configurations for different robot configurations
* To study the dynamic equation of motion and trajectory planning of a robot

UNIT - I

Direct Kinematics and Inverse kinematics
Links joints and their parameters, Kinematic Modeling of the manipulator, Denavit – Hartenberg notation, Kinematic relationship between adjacent links, Manipulator transformation matrix, Problems, Manipulator workspace, Solvability of inverse kinematic model, Existence of solution, Multiple solutions, Solution technique, Closed form solution, Guidelines to obtain closed form solutions, Problems.

15 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos, Laboratory Demonstrations and Active Learning of Direct and Inverse Kinematics.

UNIT – II

Manipulator Differential Motion and Statics
Linear and angular velocity of rigid body, Linear velocity, Angular velocity, Linear velocity due to angular motion, Combined linear and angular motion, Relationship between transformation matrix and angular velocity, Mapping velocity vector, Velocity propagation of a link, Angular velocity of a link, Manipulator Jacobian, Jacobian computation, The prismatic joint Jacobian, The rotary joint Jacobian, Jacobian inverse, Jacobian singularity, Computation of singularities, Wrist singularities, Arm singularities and singular configurations.

15 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos, Laboratory Demonstrations and Active Learning of Robot Jacobian and robot singularities.

UNIT – III

Robot Dynamics
Lagrangian mechanics, Two degree of freedom manipulator – dynamic model, Lagrange – Euler formulation, Velocity of a point on the manipulator, The inertia tensor, the kinetic energy, The potential energy, Equation of motion, The LE dynamic model algorithm, Derivation of Dynamic equation of motion for 2DOF robot configuration.

Robot Trajectory Planning and Control
Definitions and planning tasks, Terminology, joint space techniques, Use of a p- Degree polynomial as interpolation function, Cubical polynomial trajectories, Linear function with parabolic blends, Cartesian space techniques, A straight –line path, A circular path, Position path, Orientation path, Joint-space versus Cartesian space, trajectory planning, problems

09 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos, Laboratory Demonstrations and Practical Experiments

List of PBL Experiments

1.	Experiments on direct kinematics using pipe models of 3R, SCARA, RPY robots
2.	Experiments on inverse kinematics using pipe models of 3R, SCARA, RPY robots
3.	Experiments on Linear joint Jacobian
4.	Experiments on Rotary joint Jacobian

5.	Experiments on Estimation of Jacobian for
	   (a) 2R robot
	   (b) 3R robot
	   (c) RPY wrist

6.	Experiments on Robot Singularities for
	   (a) 2R robot
	   (b) 3R robot
	   (c) RPY wrist

7.	Experiments on simulation of cubic polynomial trajectory
8.	Experiments on simulation of trapezoidal velocity trajectory
9.	Dynamic simulation of 2R robot

* PBL course

Course outcome (Course Skill Set)
At the end of the course the student will be able to:
1. Calculate the direct kinematic solution for a given robot configuration
2. Calculate the inverse kinematic solution for given robot configuration
3. Calculate the Jacobian matrix for the given robot configuration
4. Identify the singular configurations for the given robot configuration
5. Calculate the dynamic equation of motion and to perform the trajectory planning for the given robot configuration

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

MSE I	20 Marks
MSE II	20 Marks
Task	10 Marks
Total	50 Marks

Semester End Examination:
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**.

Suggested Learning Resources:
Books
Robotics and Control , R K Mithal and I J Nagrath , McGraw Hill
Fu, K., Gonzalez, R. and Lee, C. S. G., Robotics: Control, Sensing, Vision and Intelligence, McGraw- Hill, 2008
Introduction to Robotic Analysis - Niku, S.B., Systems, Applications, Pearson Education, 2008.

Introduction to Robotics: Mechanics and Control- 2nd Edition - Craig, J. J., Addison-Welsey, 2nd Edition1989.

Fundamentals of Robotics, Analysis and Control- Schilling R. J., PHI, 2006.

Web links and Video Lectures (e-Resources):
https://onlinecourses.nptel.ac.in/noc20_me53/preview
https://www.classcentral.com/course/swayam-mechanics-and-control-of-robotic-manipulators-43637

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
http://vlabs.iitkgp.ac.in/mr/#

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI503 / KINEMATICS AND DYNAMICS OF ROBOT															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI503.1	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-
C-21RI503.2	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-
C-21RI503.3	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-
C-21RI503.4	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-
C-21RI503.5	3	3	2	-	-	-	-	-	-	-	-	-	3	2	-

1: 1ow   2: Medium   3: High

CONTROL ENGINEERING			
Course Code	21RI504	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:
Understand the basic concept of control Engineering.
- Understand the basic concept of control Engineering and to obtain mathematical model and transfer function of control system.
- Obtain overall transfer function of the system by reduction algebra and signal flow graph.
- Obtain the response equation of control system.
- Understand the concept of stability and obtain the stability of system using Nyquist and Bode methods.
- Obtain the system gain for stability by root locus plot and to understand the basic concept of control action.

UNIT - I

Modelling of Systems and Block diagram: Introduction to Control Systems, Types of Control Systems, with examples. Concept of mathematical modelling of physical systems- Mechanical, Translational (Mechanical accelerometer, systems excluded), and Rotational systems. Introduction to Block diagram algebra, block diagram reduction. Numerical problems on all topics.
State space Analysis: Concept of state, state variables and state model. State diagrams and State models for Linear continuous-time systems (Electrical systems): State space representation using Physical and Phase variables. Derivation of transfer functions from the state model. Numerical problems on all topics.
Signal Flow graph: Introduction to Signal Flow graph, Mason's gain formula. Obtaining Transfer functions for the given SFG using Mason's gain formula.   **15 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT – II

Time response analysis: Introduction. Standard test signals, response of first order & second order systems for UNIT step input. Steady state errors & Error constants. Numerical problems on all topics.
Concepts of stability: The Concept of stability. Necessary conditions for stability. Routh Hurwitz stability criterion. Relative stability analysis using RH Criterion.
Frequency domain Analysis: Polar and rectangular plots for the frequency response, Nyquist stability criterion, stability analysis. Phase and gain margin. **Bode diagrams:** Stability analysis using Bode diagrams.   **15 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation, simulation

UNIT – III

The Root Locus Technique: Introduction. Root locus concepts. Construction of root loci. Stability analysis using Root locus Technique Numerical problems on all topics.
Design of Control Systems: Introduction, Design with the PD Controller, Design with the PI Controller, Design with the PID Controller, Design with Phase-Lead Controller, Design with Phase - Lag Controller, Design with Lead-Lag Controller

09 Hours

Course outcome (Course Skill Set)

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

1. Illustrate open loop and closed loop control systems real life examples. Develop the mathematical model and transfer function of mechanical, electrical, hydraulic, and thermal systems by applying the knowledge of mathematics and physics.
2. Reduce the block diagram to open loop form using block diagram reduction algebra and signal flow graph (Mason's gain formula) in order to calculate overall transfer function of the system.
3. Develop the time response of 1st and 2nd order systems for UNIT step input. Calculate parameters of 2nd order under damped system response. Describe stability concept of control system and also Analyse the stability of the control system using R-H criterion.
4. Analyse the stability of the control system using Nyquist criterion and Bode plot.
5. Analyse the parameters related to stability of control systems using root locus plot. Describe the different types of control actions in control systems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

MSE I	20 Marks
MSE II	20 Marks
Task	10 Marks
Total	50 Marks

Semester End Examination:

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**.

Suggested Learning Resources:

Books

1. Katsuhiko Ogata (2004) " Modern Control Engineering" Prentice Hall of India Ltd., New Delhi
2. I. J. Nagarath and M. Gopal,(2002) "Control system" New Age International Publisher
3. Harrison H.L. and Bollinger J.G. (1968) "Automatic controls", 2PndP edition, Interna¬tional TEXTBOOK Co. U.S.A.
4. Gopal M (2005) " Modern Control Systems", New Age International Publisher
5. Benjamin.Kuo.C. (1995) "Automatic Control Systems", EEE, 7PthP Edition Prentice Hall of India Ltd. New Delhi
6. Appukuttan K. K. Control Engineering, Oxford university publication, 2009

Web links and Video Lectures (e-Resources):

1.   http://nptel.ac.in/courses/108101037/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Virtual Lab link- http://vlabs.iitkgp.ernet.in/rcs/
- https://www.mathworks.com/solutions/control-systems.html

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI504/ Control Engineering															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI504.1	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
C-21RI504.2	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
C-21RI504.3	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
C-21RI504.4	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
C-21RI504.5	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2

1: 1ow   2: Medium   3: High

AI AND ML LAB			
Course Code	21RI505	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(0:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	03

Course Learning Objectives:

1. Make use of Data sets in implementing the machine learning algorithms
2. Implement the machine learning concepts and algorithms in any suitable language of choice
3. Apply metrics and evaluate the models built.

Experiments

1. Introduction to Pandas, dataframes and other libraries of Python
2. Implement and Demonstrate Depth First Search Algorithm on any AI problem.
3. Implement and Demonstrate Best First Search Algorithm on any AI problem.
4. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
5. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print the output predictions.

6. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using the standard Heart Disease Data Set.
7. Demonstrate the working of SVM classifier for a suitable data set
8. Demonstrate the working of the Random Forest algorithm. Use an appropriate data set for building and apply this knowledge to classify a new sample.
9. Experiment on anomaly detection
10. Experiment on identifying sound sources.
11. Experiments on AI Autonomous cars in different track arenas

Course outcomes:

At the end of the course the student will be able to:
1. Make use of Data sets in implementing the machine learning algorithms
2. Implement the machine learning concepts and algorithms in any suitable language of choice
3. Use metrics and evaluate the models built.

Assessment Details (both CIE and SEE)

Continuous Internal Evaluation (CIE): The CIE marks awarded in case of Practical shall be based on the weekly evaluation of laboratory journals/ reports after the conduction of every experiment and one practical test.

Semester End Evaluation (SEE): The practical examinations to be conducted as per the time table of University in a batch wise with strength of students not more than 10-15 per batch.

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Suggested Learning Resources:
● Artificial intelligence and machine learning lab from laboratory manual

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI505 / AI and ML Lab															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI505.1	3	3	2	3	3	-	-	-	-	-	-	3	3	3	3
C-21RI505.2	3	3	2	3	3	-	-	-	-	-	-	3	3	3	3
C-21RI505.3	3	3	2	3	3	-	-	-	-	-	-	3	3	3	3

1: 1ow   2: Medium   3: High

RESEARCH METHODOLOGY AND IPR			
Course Code	21HU511	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(2:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	25	Total Marks	100
Credits	2	Exam Hours	3

Course Learning Objectives:
1. To explain the significance of carrying out research work,
2. To explain the Research Problem, Review the literature.
3. To understand Research Design, methodological way of execution.
4. To understand Data Collection, and Interpretation and Report Writing.
5. To appreciate the importance of Intellectual property rights protection.

UNIT - I

Research Methodology:
Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method.

Defining the Research Problem:
Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Reviewing the literature:
Place of the literature review in research, Bringing clarity and focus to your research problem, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

9 Hours

UNIT - II

Research Design:
Need for Research Design, Features of a Good Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Design of Sample Surveys:
Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Data Collection:
Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Interpretation and Report Writing:

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout.

Interpretation and Report Writing (continued):

Types of Reports, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

9 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT - III

Introduction to Intellectual Property

Intellectual Property (IP) – Importance, Jurisprudential definition and concept of property, rights, duties and their correlation; evolution of IPR – Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications.

Agreements and Treaties

TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; Indian Patent Act 1970 & recent amendments – Patent (Amendment) Rules, 2017.

Basics of Patents and Concept of Prior Art

Introduction to Patents; Types of patent applications, Specifications: Provisional and complete; Forms and fees Invention in the context of "prior art". Patent databases

Patent filing procedures

National & PCT filing procedure; Status of the patent applications filed; Structure of Patent document, Precautions while patenting – disclosure/non-disclosure; Patent licensing and agreement; Patent infringement- meaning, scope, litigation.

7 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

Course outcome (Course Skill Set)

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

CO1: Explain the significance of carrying out research work and identifying a research problem and perform e literature review.

CO2: Explain the Research Design, methodological way of execution, Data Collection, and Interpretation and Report Writing.

CO3: Explain the importance of Intellectual property rights and patents.

PO-CO mapping

Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1							3					1
CO 2	3	3	2			1	1								1
CO 3	1	1				3	2	2		3					1

1: Low   2: Medium   3: High

CIE Scheme

Assessment	Weightage in marks
MSE -I	20 marks
MSE -II	20 marks
Task –I	5 marks*
Task –II	5 marks
TOTAL	50marks

 * Students shall be made to review literature and prepare aa report.

Scheme for Semester End Examination

UNIT	8 questions to be set of 20 marks each	Instructions
I	Q.NO.1, Q.NO. 2, Q.NO.3	Solve any two out of 3
II	Q.NO.4, Q.NO. 5, Q.NO. 6	Solve any two out of 3
III	Q.NO.7, Q.NO. 8	Solve any one out of 2

Books
TEXTBOOKS:
1 Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg, New Age International
4th Edition, 2018
2 Research Methodology a step-by step guide for beginners. (For the topic Reviewing the literature under module 2), Ranjit Kumar, SAGE Publications Ltd . 3rd Edition, 2011
3 Study Material (For the topic Intellectual Property under module 5) Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013

REFERENCE BOOKS:
1 Research Methods: the concise knowledge base Trochim Atomic Dog Publishing 2005.
2 Conducting Research Literature Reviews: From the Internet to Paper Fink A Sage Publications, 2009

Web links and Video Lectures (e-Resources):
   NPTEL course material related to operations management, operations research and entrepreneurship

ENVIRONMENTAL STUDIES

Course Code	21RI507	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(1:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	3

Course Learning Objectives:
- To identify the major challenges in environmental issues and evaluate possible solutions.
- Develop analytical skills, critical thinking and demonstrate socio-economic skills for sustainable development.
- To analyze an overall impact of specific issues and develop environmental management plan.
- To understand the waste management and disposal system.
- To understand the environmental acts and regulations followed in environmental studies.

UNIT - I

Introduction: Environment - Components of Environment Ecosystem: Types & Structure of Ecosystem, Balanced ecosystem Human Activities – Food, Shelter, And Economic & Social Security.
Impacts of Agriculture & Housing Impacts of Industry, Mining & TransportationEnvironmental Impact Assessment, Sustainable Development.
Natural Resources, Water resources – Availability & Quality aspects, Water borne diseases &water induced diseases, Fluoride problem in drinking water Mineral resources, ForestWealth Material Cycles – Carbon Cycle, Nitrogen Cycle & Sulphur Cycle.
Energy – Different types of energy, Conventional sources & non-Conventional sources of energy Solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Biomass &Biogas Fossil Fuels, Hydrogen as an alternative energy.   **6 Hours**

Pedagogy	Chalk and talk, Power point presentation, Videos, animations, Case studies, Presentation by the students

UNIT – II

Environmental Pollution – Water Pollution, Noise pollution, Land Pollution, Public Health Aspects.
Global Environmental Issues: Population Growth, Urbanization, Land Management, Water & Waste Water Management.
Air Pollution & Automobile Pollution: Definition, Effects – Global Warming, Acid rain & Ozone layer depletion, controlling measures.
Solid Waste Management, E - Waste Management & Biomedical Waste Management -Sources, Characteristics & Disposal methods.   **6 Hours**

Pedagogy	Chalk and talk, Power point presentation, Videos, animations, Case studies, Presentation by the students

UNIT – III

Introduction to GIS & Remote sensing, Applications of GIS & Remote Sensing inEnvironmental, Engineering Practices.
Environmental Acts & Regulations, Role of government, Legal aspects, Role of Non-governmental Organizations (NGOs), Environmental Education & Women Education.   **3 Hours**

Pedagogy	Chalk and talk, Power point presentation, Videos, animations, Case studies, Presentation by the students

Course Outcome (Course Skill Set)

Students will be able to,

1. Understand the principles of ecology and environmental issues that apply to air,land, and water issues on a global scale,
2. Develop critical thinking and/or observation skills, and apply them to the analysisof a problem or question related to the environment,
3. Demonstrate ecology knowledge of a complex relationship between biotic andabiotic components
4. Apply their ecological knowledge to illustrate and graph a problem and describethe realities that managers face when dealing with complex issues.
5. Apply the environmental acts and regulations in environmental education.

Assessment Details (both CIE and SEE)

(methods of CIE need to be define topic wise i.e.- MCQ, Quizzes, Open book test, Seminar or micro project)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

- Methods suggested: Test, Open Book test, Written Quiz, Seminar, report writing etc.
- The class teacher has to decide the topic for closed book test, open book test, Written Quiz and Seminar. In the beginning only teacher has to announce the methods of CIE for the subject.

Semester End Examination:

Theory SEE will be conducted by University as per scheduled time table, with common question papers for subject

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

Suggested Learning Resources:

BOOKS

1. Benny Joseph (2005), **"Environmental Studies"**, Tata McGraw – Hill PublishingCompany Limited.
2. R.J.Ranjit Daniels and Jagadish Krishnaswamy, (2009), **"Environmental Studies",** Wiley   India Private Ltd., New Delhi.
3. R Rajagopalan, **"Environmental Studies – From Crisis to Cure**", OxfordUniversity   Press, 2005,
4. Aloka Debi, **"Environmental Science and Engineering",** Universities Press (India)Pvt. Ltd. 2012.
5. Raman Sivakumar, **"Principals of Environmental Science and Engineering",** Second Edition, Cengage learning Singapore, 2005
6. P. Meenakshi, **"Elements of Environmental Science and Engineering",** PrenticeHall   of India Private Limited, New Delhi, 2006
7. S.M. Prakash, **"Environmental Studies",** Elite Publishers Mangalore, 2007
8. Erach Bharucha, **"TEXTBOOK of Environmental Studies"**, for   UGC, Universitypress, 2005
9. G.Tyler Miller Jr., **"Environmental Science – working with the Earth"**, TenthEdition, Thomson Brooks /Cole, 2004
10. G.Tyler Miller Jr., **"Environmental Science – working with the Earth"**, EleventhEdition, Thomson Brooks /Cole, 2006
11. Dr.Pratiba Sing, Dr.AnoopSingh and Dr.Piyush Malaviya, **"Text Book of Environmental and Ecology",** Acme Learning Pvt. Ltd. New Delhi.

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=LjFt7rlCU84

https://www.youtube.com/watch?v=kXCFFupDK0g

https://www.youtube.com/watch?v=PwmSa09Cl6E

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

https://www.youtube.com/watch?v=PwmSa09Cl6E

COURSE ARTICULATION MATRIX:

Course Outcomes (CO)	Program Outcomes (PO)												PSO		
Course Code / Name : 21RI507 / Environmental Studies															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI507.1	-	-	-	-	-	-	3	2	-	1	-	2	-	-	-
C-21RI507.2	-	-	-	-	-	-	3	2	-	1	-	2	-	-	-
C-21RI507.3	-	-	-	-	-	-	3	2	-	1	-	2	-	-	-
C-21RI507.4	-	-	-	-	-	-	3	2	-	1	-	2	-	-	-
C-21RI507.5	-	-	-	-	-	-	3	2	-	1	-	2	-	-	-

1: 1ow   2: Medium   3: High

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Ability Enhancement Course-V

CNC PROGRAMMING AND MACHINING			
Course Code	21RI313	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(1:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	3

Course Learning Objectives:
- Explain applications, advantages of CNC machines and technology, study various controllers used in CNC machines
- Understand the codes (G-code and M-Code) used in CNC machines for programming
- Simulate the prepared part programme using available simulation software.

UNIT – I

Introduction: Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning center, machining center, grinding machine, EDM.

3 Hours

Controllers for CNC machines: Types of control systems, CNC controllers: Fanuc, Siemens, MACH 3 & MACH 4, NC-Studio.

3 Hours

CNC Programming: Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, manual part programming for machining centre and turning centre.

3 Hours

Pedagogy	Live examples, Live project

UNIT - II

CNC Program Simulation: Simulate the part program using available simulation software

3 hours

Automatic NC Program generation: Execute program for machining a simple part

3 hours

Pedagogy	Live examples, Live project

Course Outcome (Course Skill Set)

- Explain applications, advantages of CNC machines and technology, Identify various controllers used in CNC machines, Develop CNC programming skill using the codes (G-code and M-Code)
- Simulate the part program using available simulation software, Execute program for machining a simple part

Assessment Details (both CIE and SEE)
(methods of CIE need to be define topic wise i.e.- MCQ, Quizzes, Open book test, Seminar or micro project)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.
Continuous Internal Evaluation:
- Methods suggested: Test, Open Book test, Written Quiz, Seminar, report writing etc.
- The class teacher has to decide the topic for closed book test, open book test, Written Quiz and Seminar. In the beginning only teacher has to announce the methods of CIE for the subject.

Semester End Examination:
Theory SEE will be conducted by University as per scheduled time table, with common question papers for subject

Suggested Learning Resources:

TEXTBOOKS:
1. CNC Machines, Pabla B.S., Adithan M., New Age International, New Delhi,2014(reprint).
2. CAD/CAM: computer aided design and manufacturing, Groover Mikell P, Zimmered W Emory, Prentice Hall 2014
3. Computer Numerical Control- Turning and Machining centers. Quesada Robert, Prentice Hall 2014

Web links and Video Lectures (e-Resources):

1. https://www.classcentral.com/course/youtube-computer-numerical-control-cnc-of-machine-tool-and-process-47871
2. https://www.udemy.com/course/mastering-artcam-2017/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
- https://fab-coep.vlabs.ac.in/exp1/Video.html?domain=Mechanical%20Engineering&lab=FAB%20laboratory
- http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/exp2/index.html#

COURSE ARTICULATION MATRIX:

Course Code / Name: 21RI313 / CNC Programming and Machining															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI413.1	1	2	1	-	-	-	-	-	-	-	-	1	3	3	3
C-21RI413.2	2	2	1	-	-	-	-	-	-	-	-	1	3	3	3

CNC TECHNOLOGIES			
Course Code	21RIA51	CIE Marks	50

Teaching Hours/Week (L:T:P: S)	(1:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	3

Course Learning Objectives:
- Explain applications, advantages of CNC machines and technology, study various controllers used in CNC machines
- Understand the codes (G-code and M-Code) used in CNC machines for programming
- Simulate the prepared part programme using available simulation software.

UNIT – I

Introduction: Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning center, machining center, grinding machine, EDM.

3 Hours

Controllers for CNC machines: Types of control systems, CNC controllers: Fanuc, Siemens, MACH 3 & MACH 4, NC-Studio.

3 Hours

CNC Programming: Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, manual part programming for machining centre and turning centre.

3 Hours

Pedagogy	Live examples, Live project

UNIT – II

CNC Program Simulation:
1. **Simulate the Tool Path and Generate the NC Code for Machining (CAM Software):**
To create tool paths and NC code for machining processes like milling and turning using Computer-Aided Manufacturing (CAM) software.
2. **Generating NC Code by Slicing for 3D Printing:**
   To prepare for 3D printing, the 3D model is sliced into layers, and NC code is generated to guide the 3D printer. **3 hours**

Automatic NC Program generation:
Execute NC program to prototype a simple part using
1. CNC milling machine
2. 3D printing machine

3 hours

Pedagogy	Live examples, Live project

Course Outcome (Course Skill Set)
- Explain applications, advantages of CNC machines and technology, Identify various controllers used in CNC machines, Develop CNC programming skill using the codes (G-code and M-Code)
- Simulate the part program using available simulation software, Execute program for machining a simple part

Assessment Details (both CIE and SEE)
(methods of CIE need to be define topic wise i.e.- MCQ, Quizzes, Open book test, Seminar or micro project)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.
Continuous Internal Evaluation:
- Methods suggested: Test, Open Book test, Written Quiz, Seminar, report writing etc.
- The class teacher has to decide the topic for closed book test, open book test, Written Quiz and Seminar. In the beginning only teacher has to announce the methods of CIE for the subject.

Semester End Examination:
Theory SEE will be conducted by University as per scheduled time table, with common question papers for subject

Suggested Learning Resources:
Books
1. CNC Machines, Pabla B.S., Adithan M., New Age International, New Delhi,2014(reprint).
2. CAD/CAM: computer aided design and manufacturing, Groover Mikell P, Zimmered W Emory, Prentice Hall 2014
3. Computer Numerical Control- Turning and Machining centers. Quesada Robert, Prentice Hall 2014
Web links and Video Lectures (e-Resources):
1. https://www.classcentral.com/course/youtube-computer-numerical-control-cnc-of-machine-tool-and-process-47871
2. https://www.udemy.com/course/mastering-artcam-2017/
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
• https://fab-coep.vlabs.ac.in/exp1/Video.html?domain=Mechanical%20Engineering&lab=FAB%20laboratory
• http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/exp2/index.html#

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RIA51 / CNC TECHNOLOGIES															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RIA51.1	-	-	-	-	-	2	-	2	-	-	2	2	-	-	-
C-21RIA51.2	-	-	-	-	-	2	-	2	-	-	2	2	-	-	-

1: low   2: Medium   3: High

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STARTUP POLICY AND GENERAL COMPLIANCES			
Course Code	21RIA52	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(1:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	02

Course Learning Objectives:
- Comprehend the role of bounded rationality, framing, causation and effectuation in entrepreneurial decision making.
- Demonstrate an ability to design a business model canvas, Evaluate the various sources of raising finance for startup ventures and understand the fundamentals of developing and presenting business pitching to potential investors

UNIT - I
Entrepreneurial Process and Decision Making: Entrepreneurial ecosystem, Ideation, development and exploitation of opportUNITies; Negotiation, decision making process and approaches**,** Effectuation and Causation
Fundamentals of choosing the Business Organization form for startup: Why we need a business form for startup? How to choose appropriate business form for startup? Comparative analysis of Incorporation requirement. Comparative Analysis of compliance cost, Other formalities to comply.

8 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT – II

Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer focused innovation; building and analyzing business models; Business model canvas, Introduction to lean startups, Business Pitching.

Organizing Business and Entrepreneurial Finance: Forms of business organizations; organizational structures; Evolution of Organisation, sources and selection of venture finance options and its managerial implications. Policy Initiatives and focus; role of institutions in promoting entrepreneurship.

Laws relating to incorporation of Partnership, LL.P & Co – operative, Laws relating to incorporation of One Person Company, Pvt. Ltd., Pub. Ltd. And not for profit company

7 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

Course Outcome (Course Skill Set)

At the end of the course the student will be able to :
1. Explain the role of bounded rationality, framing, causation and effectuation in entrepreneurial decision making and Demonstrate an ability to design a business model canvas.
2. Evaluate the various sources of raising finance for startup ventures and Explain the fundamentals of developing and presenting business pitching to potential investors.

Assessment Details (both CIE and SEE)

(methods of CIE need to be define topic wise i.e.- MCQ, Quizzes, Open book test, Seminar or micro project)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

1. Methods suggested: Test, Open Book test, Written Quiz, Seminar, report writing etc.
2. The class teacher has to decide the topic for closed book test, open book test, Written Quiz and Seminar. In the beginning only teacher has to announce the methods of CIE for the subject.

Semester End Examination:

Theory SEE will be conducted by University as per scheduled time table, with common question papers for subject
1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

TEXTBOOKS:
1. Ries, Eric(2011), The lean Start-up: How constant innovation creates radically successful businesses, Penguin Books Limited.
2. Blank, Steve (2013), The Startup Owner's Manual: The Step by Step Guide for Building a Great Company, K&S Ranch. S. Carter and D. Jones-Evans, Enterprise and small business- Principal Practice and Policy, Pearson Education (2006)
3. Corporate Law, 33rd ed. 2016, Taxman New Delhi.
4. Ramaiya's Guide to the Companies Act, 18th ed. 2014, Lexis Nexis New Delhi.
5. C R Dutta on Company Law, 8th ed. 2008, Lexis Nexis New Delhi.
6. Pollock & Mulla's Indian PartnershipAct, 7th ed. 2011, Lexis Nexis New Delhi.
7. Taxman's LLP Manual 4th ed. 2015, Taxman, New Delhi.

Web links and Video Lectures (e-Resources):
- . https://nptel.ac.in/courses/109/105/109105098/

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RIA52 / Start-up Policy and General Compliances															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI512.1	-	-	-	-	-	2	-	2	-	-	2	2	-	-	-
C-21RI512.2	-	-	-	-	-	2	-	2	-	-	2	2	-	-	-

1: 1ow   2: Medium   3: High

PLC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS

Course Code	21RIA53	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(1:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	02

Course Learning Objectives:
- To understand the fundamentals of fluid power transmission systems, various hydraulic components, various pneumatic components.
- Learn various types of hydraulic and pneumatic power circuits and applications in fluid power circuits.

UNIT – I

PLC Architecture and Types, Hydraulic and Pneumatic System Components, PLC Programming	**08 Hours**
Pedagogy	Chalk and talk method, Power Point Presentation, Demonstration of different PLC UNITs

UNIT - II

Hydraulic & Pneumatic Circuit Design, PLC Programming for Hydraulic and Pneumatic Circuits	**07 Hours**
Pedagogy	Chalk and talk method, Power Point Presentation, design and simulation of pneumatic and hydraulic circuits using FluidSIM software and hands-on experiments, controlling of hydraulic and pneumatic circuit using PLC

Course Outcome (Course Skill Set)

At the end of the course the student will be able to:
1. Explain the working principle of hydraulic systems including pumps, control components and pneumatic systems and their components.
2. Design various types of hydraulic and pneumatic power circuits and their applications in fluid power circuits.

Assessment Details (both CIE and SEE)

(methods of CIE need to be define topic wise i.e.- MCQ, Quizzes, Open book test, Seminar or micro project)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:
1. Methods suggested: Test, Open Book test, Written Quiz, Seminar, report writing etc.
2. The class teacher has to decide the topic for closed book test, open book test, Written Quiz and Seminar. In thebeginning only teacher has to announce the methods of CIE for the subject.

Semester End Examination:

Theory SEE will be conducted by University as per scheduled time table, with common question papers for subject
1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books
1. Majumdar S.R., "Pneumatic systems - Principles and maintenance", Tata McGraw Hill, 2008
2. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2009.
3. Majumdar S.R., "Oil Hydraulics", Tata McGraw-Hill, 2000.
4. Harry L. Stevart D.B, "Practical guide to fluid power", Taraoeala sons and Port Ltd.Broadey, 2010.
5. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 2011.
6. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 2011.

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RIA53 / PLC Control of Hydraulic and Pneumatic Circuits															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RIA53.1	2	2	3	3	3	-	-	-	-	-	-	3	2	1	2
C-21RIA53.2	2	2	3	3	3	-	-	-	-	-	-	3	2	1	2

1: 1ow   2: Medium   3: High

ENGINEERING ECONOMICS

Course Code	21RIA54	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(1:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	02

Course Learning Objectives:
- Evaluate the worth of creations, by comparing the alternatives visa, visa the cost (cost- benefit analysis) and take decisions with the limited resources, the relevant course of action, with the help of suitable tools.
- Determine the cost involved in each operation, a product should undergo with an aim to fix suitable selling price for the product and know the different terminology of Economics and to prepare ledgers, journals, balance sheets and profit and loss accounts

UNIT – I

Fundamental economic concepts: Consumer goods, Producer goods, Factors of production, Economy of organization, Demand theory, Law of demand, Exceptions to law of demand, Law of supply, Determinants of supply, Law of increasing returns and law of diminishing returns(No exercises)

Interest: Rate of interest, Determining rate of interest, Time value of money, Simple interest, Compound interest, Nominal and effective interest rate, Equivalence involving interest, Interest formulae [single payment, uniform series and arithmetic gradient only], problems using interest formulae [discrete compounding only].

Economic Analysis of Alternatives Analysis based on: Present Worth [equal life and unequal life situations], Future Worth, Payback Period, Capitalized Worth, Equivalent Annual Worth, Exercises. **8 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT – II

Rate of Returns: Analysis based on Rate of Return, Exercises, cost of capital concepts

Depreciation: Causes of depreciation, Depletion, Methods of depreciation [Straight line, Declining balance, Double declining balance, SYD method, Sinking Fund method], Exercises

Financial management: Terminologies used in accounting, Journal and ledger, Profit and loss statement, Balance sheet, Understanding basic financial ratios, Simple exercises.

Estimating and Costing: Components of cost [Material cost, Labour cost, Overhead expenses, Prime cost, Factory cost, Total cost], Determination of selling price of a product, Exercises

Mensuration: Machine shop calculations, Forging shop calculations, Exercises **7 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation

Course Outcome (Course Skill Set)

At the end of the course the student will be able to:
1. Evaluate the worth of creations, by comparing the alternatives visa, vis the cost (cost- benefit analysis) and take decisions with the limited resources, the relevant course of action, with the help of suitable tools.
2. Determine the cost involved in each operations, a product should undergo with an aim to fix suitable selling price for the product and Know the different terminology of Economics and to prepare ledgers, journals, balance sheets and profit and loss accounts.

Assessment Details (both CIE and SEE)

(methods of CIE need to be define topic wise i.e.- MCQ, Quizzes, Open book test, Seminar or micro project)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:
1. Methods suggested: Test, Open Book test, Written Quiz, Seminar, report writing etc.
2. The class teacher has to decide the topic for closed book test, open book test, Written Quiz and Seminar. In the beginning only teacher has to announce the methods of CIE for the subject.

Semester End Examination:
Theory SEE will be conducted by University as per scheduled time table, with common question papers for subject
- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub questions), should have a mix of topics under that module.
- The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:
Books
1. Engineering Economics, Riggs J.L.,4th edition, Tata McGraw-Hill, 2004
2. Mechanical Estimating and Costing, Banga and Sharma, 16th edition, Khanna Publishers, 2012
3. Engineering Economy, E Paul Degarmo, Macmillan Publishing, 2001
4. Engineering Economy, Gerald J Thuesen & W J Fabrycky, Prentice Hall of India, 9th ed.
5. Engineering Economics, Tarachand, Nemchand & Bros, 1996
6. Financial Management, I M Pandey, Vikas Publishing House, 2002

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RIA54 / Engineering Economics															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RIA54.1	3	2	2	1	2	-	-	-	-	-	3	3	-	-	-
C-21RIA54.2	3	2	2	1	2	-	-	-	-	-	3	3	-	-	-

1: 1ow   2: Medium   3: High

FUNDING OPPORTUNITIES AND RESEARCH PROPOSALS			
Course Code	21RI515	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(1:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	02

Course Learning Objectives:
This course will provide an introduction to the basic skills, principles and techniques of successful grant writing. Students completing the course will:
- To Understand the fundamental components of a grant proposal such as the abstract or summary, background and significance, specific aims/goals and objectives, project design and methods, sustainability, assessment, broader impacts, dissemination, budget, budget justification, and cover letter as well as the overall grant submission process.
- To Learn how to locate available funding opportUNITies and develop the skills needed to develop competitive grant proposals.

UNIT- I

Why Write a Grant?

The Language of Grantsmanship, Developing a Professional Growth Plan Using a Research Career Trajectory, A Research Career Trajectory, Personal Attributes of Successful Researchers , Overcoming Barriers to Grantsmanship.

Becoming Familiar With Funding Sources:

Sources of Funding, Learning About and Keeping Track of Funding Sources ,Interpreting Calls for Proposals.

Developing Your Ideas for Funding:
Identifying Ideas With Funding Potential, Ideas That Are Hot and Those That Are Not, Matching an Idea to a Funding Priority
Common Sections of Proposals
Description of Common Proposal Sections for Research, Training, and Demonstration Grants
Strategies for Effective Writing
Organizing for the Writing Task , Problems With Writing,
Technical Writing Considerations
Elements of a Concept Paper , Needs Assessments, Pilot Studies , Obtaining Contractual Agreements and Letters of Support, Other Administrative Matters
Developing a Budget : The Language of Grant Budgets , Considerations in Developing a Budget , Basic Components of a Budget , Budget Justification , NIH Modular Budget Format, Putting It All Together to Create a Budget .
Constructing a Budget : Thinking Through Project Costs ,Consultation and Subaward ConsiderationsTechnical Considerations in Budget Development Governance of Budgets, Budget Forms, Assuring Budget Accuracy
Models for Proposal Development
Individual Model, Consultative Model, Cooperative Model, Collaborative Model, Choosing an appropriate Project Structure

8 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - II

Understanding the Process of Collaboration

   Theoretical Framework for Understanding Collaboration , Roles and Responsibilities of Team Members, Five-Stage Model of Collaboration

Forming a Collaborative Team

Forming a Collaborative Team and Evaluating Its Effectiveness , Common Problems in Collaborative Teams and Effective Solutions
Submitting the Proposal

Learning About Your Institution , Questions to Ask of Your Institution , Institutional Review Board Procedures
  Electronic Considerations

  Benefits of Online Grant, Submissions , Common Challenges With Electronic Submissions , Getting Ready for Electronic Submission, The Process.

  Life After a Grant Submission

  Understanding the Review Process , Structure of the Review Process , Review Criteria , Scores and Categories of Acceptance and Rejection , Tips for Understanding the Review Process.

  Responding to the Proposal Review

Resubmission Options , Considerations in Reading, Reviewer Comments , Resubmission Process .

7 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

Course Outcome (Course Skill Set)

At the end of the course the student will be able to :
1. Explain the fundamental components of a grant proposal such as the abstract or summary, background and significance, specific aims/goals and objectives, project design and methods, sustainability, assessment, broader impacts, dissemination, budget, budget justification, and cover letter as well as the overall grant submission process.
2. Able to structure, present and write a research proposal, using high level written and verbal communicationskills and develop the skills needed to develop competitive grant proposals

Assessment Details (both CIE and SEE)

(methods of CIE need to be define topic wise i.e.- MCQ, Quizzes, Open book test, Seminar or micro project)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:
1. Methods suggested: Test, Open Book test, Written Quiz, Seminar, report writing etc.
2. The class teacher has to decide the topic for closed book test, open book test, Written Quiz and Seminar. In the beginning only teacher has to announce the methods of CIE for the subject.

Semester End Examination:

Theory SEE will be conducted by University as per scheduled time table, with common question papers for subject
1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

BOOKS
1. Guide to Effective Grant Writing : How to Write a Successful NIH Grant Application, Otto O.Yang, Springer, 2nd edition, 2012
2. Successful Grant Writing: Strategies for Health and Human Service Professionals Laura N. Gitlin, Kevin J. Lyons, Springer Publishing Company; 5th edition (26 May 2020)

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI515 / Funding OpportUNITies and Research Proposals															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI515.1	1	3	2	3	2	-	-	-	-	-	-	2	-	-	-
C-21RI515.2	1	3	2	3	2	-	-	-	-	-	-	2	-	-	-

1: 1ow   2: Medium   3: High

Technological Innovation Management and Entrepreneurship			
Course Code	21RI601	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:
- Define the Technological Innovation
- Explain Innovation management and the difference between Invention and Innovation.
- Appreciate the importance of Innovation as management process and Innovation management techniques.
- Define the Innovation system and explain the importance of Technology management and Transfer.
- Identify the Technological Entrepreneurship and its types and Understand the Institutional support provided for Entrepreneurs

UNIT – I

Introduction to technological innovation: Basic Concepts and Definitions: Technology - Technology Management – Invention – Creativity – Innovation - The Concept of Technological Innovation - Innovation Posture, Propensity and Performance - Innovation Measurement- Key factors linking creativity and innovation – Classifications of Innovations – Innovation Process.

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

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation, video, animation

UNIT – II

Innovation as a management process 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

Introduction to technological entrepreneurship Types of Entrepreneurships: Mixed Entrepreneurship, Pure Entrepreneurship, Social Entrepreneurship, Collaborative Entrepreneurship, Internal Entrepreneurship, External Entrepreneurship - Sustainable Entrepreneurship

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation, video, animation

UNIT – III

Institutional support Business Incubator (Bi) - Determination of the Five Incubator Services - Incubation Centres in India – Atal Incubation Centre – Startup India - NSIC, KIADB, KSFC.
9 Hours

Pedagogy	Chalk and talk method, Power Point Presentation, video, animation

Course Outcome (Course Skill Set)

At the end of the course the student will be able to :
1. **Describe** technological innovation and its key features for business.
2. **Describe** innovation management and difference between invention and innovation.
3. **Explain** innovation as a management process, its management and perspectives. Innovation management techniques.
4. **Explain** innovation system, technology management and transfer.
5. **Explain** technological entrepreneurship and institutional support.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

MSE I	20 Marks
MSE II	20 Marks
Task	10 Marks
Total	50 Marks

Semester End Examination:

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**.

Suggested Learning Resources:

BOOKS
1. Innovation and Entrepreneurship Theory, Policy and Practice, **Carayannis**, Elias G., **Samara**, Elpida T., **Bakouros**, Yannis L. Springer, 2015.
2. Digital Innovation and Entrepreneurship, Dick Whittington, Cambridge University Press, 2018
3. Entrepreneurship Development Small Business Enterprises- Poomima MCharantimath, Pearson Education 2008, ISBN 978-81-7758-260-4.
4. Principles of Management – P.C Tripathi, P.N Reddy, McGraw Hill Education, 6th Edition, 2017. ISBN-13:978-93-5260-535-4.

Web links and Video Lectures (e-Resources):

- Innovation, Business Models and Entrepreneurship by Prof . Rajat Agrawal and Prof. Vinay Sharma, IIT Roorkee. NPTEL Course (https://onlinecourses.nptel.ac.in/noc19_mg55/preview)
- https://www.coursera.org/mastertrack/innovation-management-entrepreneurship-hec

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI601 / Technological Innovation Managementand Entrepreneurship															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI601.1	2	2	1	1	1	-	-	2	-	-	2	2	2	-	1
C-21RI601.2	2	2	1	1	1	-	-	2	-	-	2	2	2	-	1
C-21RI601.3	2	2	1	1	1	-	-	2	-	-	2	2	2	-	1
C-21RI601.4	2	2	1	1	1	-	-	2	-	-	2	2	2	-	1
C-21RI601.5	2	2	1	1	1	-	-	2	-	-	2	2	2	-	1

1: 1ow   2: Medium   3: High

DRIVE SYSTEMS FOR ROBOT

Course Code	21RI602	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	04	Exam Hours	03

Course Learning Objectives:
- To gain knowledge on the application of fluid power in process, construction, and manufacturing Industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system.
- To develop a measurable degree of competence in the design, construction, and operation of fluid power circuit
- To gain knowledge on the application of fluid power in process, construction, and manufacturing Industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system.

UNIT – I

FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS
Introduction to Fluid power – Advantages and Applications,Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory– Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Problems.   **07 Hours**

PROGRAMMABLE LOGIC CONTROLLER: Introduction to PLC's, basic structure, Principle of operation, Programming and concept of ladder diagram, concept of latching of a PLC. Logic gates using PLC. PLC based electro pneumatic circuits.   **03 Hours**

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT - II

HYDRAULIC ACTUATORS AND CONTROL COMPONENTS
Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.   **04 Hours**

PNEUMATIC CIRCUITS AND SYSTEMS
Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, electro pneumatic logic circuits.   **06 Hours**

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT – III

Electrical Drives: Working principle of Servo Drives, Harmonic Drives, compact drives and Variable frequency drives and its applications
06 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

List of Experiments:	14 Hours
1.	A furnace door is opened and closed by a double-acting cylinder. The cylinder is activated by a 4/2-way valve with spring return. This ensures that the door opens only as long as the valve is actuated. When the valve actuating lever is released, the door closes again.
2.	The cover of a hardening furnace is to be raised by a single-acting cylinder. The cylinder is activated by a 3/2-way valve. A 9 kg weight is attached to the cylinder to represent the load. Measure and calculate the following values: 1. Travel pressure, load pressure, resistances and back pressure 2. Advance-stroke time and speed
3.	Design pneumatic circuit to a sorting device for metal stampings. Through operation of the push button on the actuating valve, metal stampings lying in random positions are sorted out and transferred to a second conveyor belt. The forward motion of the piston rod of a single acting cylinder (1A) takes t = 0.4 seconds. When the push button is released, the piston rod travels to the retracted end position. A pressure gauge is fitted before and after the one-way flow control valve.
4.	A double-acting cylinder (1A) guides cylinder pins towards a measuring device. The pins are separated by means of a continuous to and fro movement. The oscillating motion can be started by means of a valve with selector switch. The duration of the forward stroke of the cylinder is to be t_1 = 0.6 seconds, the return stroke t_3 = 0.4 seconds. The cylinder is to remain in the forward end position for t_2 = 1.0 seconds, resulting in a cycle time of t_4 = 2.0 seconds.
5.	Design and draw a circuit using the cascade system to operate two cylinders (A and B) which, on the operation of a start valve, produces the sequence A - B + B - A+. The cylinders should park in the positions B - A + when the start switch is in the 'off' position.
6.	A sorting device is used to sort heavy steel workpieces. When a START pushbutton is pressed, the piston rod of a double-acting cylinder pushes the adjacent workpiece off the conveyor belt.When the START pushbutton is released, the piston rod returns to its retracted end position.
7.	A double-acting hydraulic cylinder is used to open and close a furnace door. INCHING operation allows the door to be driven to any desired intermediate position. The cylinder is hydraulically clamped in all such positions.
8.	Using a rotary indexing table plastic containers are to be separated in linear sequence. By pressing a pushbutton switch the oscillating piston rod of a cylinder drives the rotary table in sequence via a pawl. When the pushbutton is pressed again, this drive is switched off.
9.	Using a diverting device parts are to be removed from one conveyor track onto another in linear sequence. By pressing a pushbutton switch the oscillating piston rod of a cylinder pushes the turntable via a pawl in stepped sequence. The parts are diverted and transported onwards in the opposite direction. By pressing another pushbutton switch the drive UNIT is switched off.
10.	Using a transfer station blocks are to be transferred from a magazine to a processing

	station. The blocks are pushed out of the magazine by cylinder 1A and transferred to the processing station by cylinder 2A. The piston rod of cylinder 2A may only return when the piston rod of cylinder 1A has reached the retracted end position. The magazine is monitored by means of a limit switch. If there are no more blocks in the magazine, it is not possible to start the cycle. This is indicated by means of an audible signal. The control is to be operated in single cycle.
11.	A stamping device can be operated from three sides. A workpiece is inserted via a guide, whereby it touches two of the three proximity swit- ches B1, B2 and B3. This causes a pneumatic cylinder 1.0 to extend via a solenoid valve (coil Y1), whereby a recess is to be stamped into the workpiece The stamping cycle is to be triggered only if two signal generators are addressed. For reasons of safety the cylinder must be prevented from advancing, if all three proximity sensors are contacted
12.	Cylinder A extends and brings a job under the stamping cylinder B. Cylinder B then extends and stamps the job. Cylinder A can return only after cylinder B has retracted fully. An electro-pneumatic control circuit and PLC Circuit has to be developed for realizing the control task.

Course Outcomes:
At the end of the course the student will be able to:
1. Comprehend the fundamentals of fluid power and hydraulic pumps, including the application of Pascal's Law and pump theory.
2. Acquire knowledge of hydraulic actuators and control components such as cylinders, motors, and various types of valves.
3. Understand pneumatic circuits and systems, including air properties, compressor design, and electro-pneumatic circuits.
4. Develop skills in designing pneumatic circuits using cascade methodology and electro-pneumatic system components.
5. Learn the operational principles of electrical drives including servo drives, harmonic drives, compact drives and variable frequency drives and their applications.

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

MSE I	20 Marks
MSE II	20 Marks
Task	10 Marks
Total	50 Marks

Semester End Examination:
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.

Suggested Learning Resources:
TEXTBOOKS:
1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, 2001.
3. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 1982.
4. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.
5. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995
6. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.
7. Shanmuga sundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.

Web links and Video Lectures (e-Resources):
- https://onlinecourses.nptel.ac.in/noc21_me51/preview
-
- https://www.coursera.org/lecture/fluid-power/hydraulics-and-pneumatics-SD8dv

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NEURAL NETWORKS AND DEEP LEARNING

Course Code	21RI603	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:
- Know the fundamentals of machine learning, its relationship with artificial intelligence, linear models for classification, dimensionality reduction and other design issues related to machine learning algorithms.
- Appreciate the use of neural networks.
- Know about support vector machines and its application.
- Provide an overview about deep learning.
- Know the application of different machine learning techniques in real life applications.

UNIT – I

Introduction: Fundamental concepts: neuron Models, basic learning rules. Single neuron, single layer neural network, multilayer neural network, Feed forward Neural networks. Loss, Gradient descent, back propagation algorithm.
Multilayer perceptron- Characteristics, error back propagation algorithm, XOR Problem, Heuristics for making the BP algorithm work better, Sequential and batch modes of learning, Generalization, Cross validation, Early stopping method of training.   **15 Hours**

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT – II

Radial basis function neural networks- Covers' theorem on Separability of patterns, XOR Problem , Comparison between MLP and RBFNN, Learning strategies- Fixed centers selected at random, Self-organized selection of centers, Supervised selection of centers , clustering algorithms, Dimensionality reduction, regularization and stability
Recursive neural networks(RNN):Introduction ,Implementation Recurrent Neural Network vs. Recursive Neural Networks ,Advantages and disadvantages.
Deep Learning: Introduction to Convolutional neural network, Motivation (Neuroscience), Convolutional layers. Additional layers, Residual Nets, Examples.
                                          15 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT – III

Recurrent Neural Networks: Building recurrent NN, **Long Short-Term Memory** (LSTM):Architecture,Working and its applications, Time Series Forecasting.

Gated recurrent UNIT networks(GRU):Understanding GRU cell, Architecture,How does GRU work, LSTM Vs GRU
Region based CNNs(RCNNs): Introduction ,Architecture, improvement series ,Pros and cons

9 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

Course outcomes:
At the end of the course the student will be able to:
1. Know the fundamental concept of neural network techniques and learning algorithms
2. Explain multi-layer perceptron in terms of its architecture, features, principle, advantages, disadvantages and applications and solve simple problems
3. Explain radial basis function network in terms of its architecture, features, principle, advantages, disadvantages and applications and solve simple problems
4. Explain support vector machines in terms of its principle, features, advantages, disadvantages and applications.
5. Know the applications of Deep learning and Explain the working Recurrent Neural Network LSTM models

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

MSE I	20 Marks
MSE II	20 Marks
Task	10 Marks
Total	50 Marks

Semester End Examination:
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**.

Suggested Learning Resources:

TEXTBOOKS:
1. Neural Networks – A comprehensive Foundation, Simon Haykin, Pearson Prentice Hall, Second Edition, 2005, ISBN 81 – 7808 -300 - 0
2. Understanding Machine Learning – from Theory to Algorithms by Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 2014, ISBN978-1-107-05713-5 Hardback
3. Pattern Recognition and Machine Learning by Christopher Bishop, Springer, 2006, ISBN:978-0-387-31073-2
4. Goodfellow, I., Bengio, Y., Courville, A., Deep Learning, Part II, MIT Press, 2016.
5. Vapnik, V., An Overview of Statistical Learning Theory, IEEE Transactions on Neural Networks,   Vol. 10, pp. 988-999, 1999.
6. Christopher Burges, A Tutorial on Support Vector Machines for Pattern Recognition, Data Mining and Knowledge Discovery, 1998.
7. Kurt Hornik, Maxwell Stinchcombe and Halbert White, Multilayer Feedforward Networks are Universal Approximators, Neural Networks, 1989.
8. Any other web based source

Web links and Video Lectures (e-Resources):
- https://nptel.ac.in/courses/106/106/106106184/
- https://onlinecourses.nptel.ac.in/noc20_cs62/preview
- https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-cs41/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
- http://cse22-iiith.vlabs.ac.in/
- http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/exp1/pretest.php

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI603/ Neural Networks and Deep Learning														
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI603.1	3	3	2	3	3	-	-	-	-	-	-	3	3	2	2
C-21RI603.2	3	3	2	3	3	-	-	-	-	-	-	3	3	2	2
C-21RI603.3	3	3	2	3	3	-	-	-	-	-	-	3	3	2	2
C-21RI603.4	3	3	2	3	3	-	-	-	-	-	-	3	3	2	2
C-21RI603.5	3	3	2	3	3	-	-	-	-	-	-	3	3	2	2

1: 1ow   2: Medium   3: High

CONTROL ENGINEERING LABORATORY

Course Code	21RI606	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(0:0:2:0)	SEE Marks	50
Credits	01	Exam Hours	03

Course Learning Objectives:
- To determine the time and frequency domain reposes of a given second order system using software package or discrete components.
- To design and analyze Lead, Lag and Lag – Lead compensators for given specifications.
- To draw the performance characteristics of ac and DC servomotors and synchro-transmitter receiver pair.
- To study the DC position & feedback control system and to study the effect of P, PI, PD and PID controller and Lead compensator on the step response of the system.
- To write a script file to plot root locus, bode plot, to study the stability of the system

Sl.NO	Experiments
1	Speed control Experiments i) Speed control of DC motor ii) Speed control of AC motor iii) Speed control of Stepper motor iv) Speed control of BLDC motor
2	Experiment to determine frequency response of a second order system
	(a) To design a passive RC lead compensating network for the given specifications, viz, the maximum phase lead and the frequency at which it occurs and to obtain the frequency response.
	(b) To design a passive RC lag compensating network for the given specifications, viz, the maximum phase lag and the frequency at which it occurs and to obtain the frequency response. (c) To determine experimentally the transfer function of the lag compensating network
4	To study a second order system and verify the effect of (a) P, (b) PI, (c) PD and (d) PID controller on the step response.
5	To simulate a typical second order system and determine step response and evaluate time response specifications. To evaluate the effect of adding poles and zeros on time response of second order system. To evaluate the effect of pole location on stability
6	To examine the relationship between open-loop frequency response and stability, open-loop frequency and closed loop transient response
7	To study the effect of open loop poles and zeros on root locus contour Comparative study of Bode, Nyquist and root locus with respect to stability.
8	To simulate a D.C. Position control system and obtain its step response.
9	To verify the effect of input waveform, loop gain and system type on steady state errors.
10	Inverted Pendulum control Experiment
11	Experiments on Height and orientation control of a Quadcopter

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:
1. Utilize software package and discrete components in assessing the time and frequency domain response of a given second order system.
2. Determine the performance characteristics of AC and DC motors used in control systems.
3. Simulate the DC position and feedback control system to study the effect of P, PI, PD and PID controller and Lead compensator on the step response of the system.
4. Develop script files to plot Root locus, Bode plot and Nyquist plot to study the stability of control system.
5. Stabilization and control of the unstable inverted pendulum system with a close-loop control system and Design a Controller for Quadcopter height and orientation

Assessment Details (both CIE and SEE)
Continuous Internal Evaluation (CIE): The CIE marks awarded in case of Practical shall be based on the weekly evaluation of laboratory journals/ reports after the conduction of every experiment and one practical test.
Semester End Evaluation (SEE): The practical examinations to be conducted as per the time table of University in a batch wise with strength of students not more than 10-15 per batch. 1. All laboratory experiments are to be included for practical examination. 2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners. 3. Students can pick one experiment from the questions lot prepared by the examiners. **4.** Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
Suggested Learning Resources: **BOOKS:** 1. Katsuhiko Ogata (2004) " Modern Control Engineering" Prentice Hall of India Ltd., New Delhi 2. I. J. Nagarath and M. Gopal,(2002) "Control system" New Age International Publisher 3. Harrison H.L. and Bollinger J.G. (1968) "Automatic controls", 2PndP edition, Interna¬tional TEXTBOOK Co. U.S.A. 4. Gopal M (2005) " Modern Control Systems", New Age International Publisher 5. Benjamin.Kuo.C. (1995) "Automatic Control Systems", EEE, 7PthP Edition Prentice Hall of India Ltd. New Delhi **6.** Appukuttan K. K. Control Engineering, Oxford university publication, 2009

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI606 / Control Engineering Lab															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI606.1	3	3	2	2	2	-	-	-	-	-	-	2	2	-	2
C-21RI606.2	3	3	2	2	2	-	-	-	-	-	-	2	2	-	2
C-21RI606.3	3	3	2	2	2	-	-	-	-	-	-	2	2	-	2
C-21RI606.4	3	3	2	2	2	-	-	-	-	-	-	2	2	-	2
C-21RI606.5	3	3	2	2	2	-	-	-	-	-	-	2	2	-	2

1: 1ow   2: Medium   3: High

Professional Elective Courses-I

PLC AND SCADA

Course Code	21RI641	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:
- Gain knowledge in the concepts of developing basic skills necessary for PLC & SCADA
- Understand the basic programming concepts and various Operation using RELAY LOGIC devices used in PLC and SCADA
- Diagnose the problem related types of I/O module, Data Acquisition System and Communication Networks(Bus Systems) using Standard Protocol.
- Understand the concepts of SCADA fundamentals.
- Understand the human machine interfacing component for control application.

UNIT – I

Programmable Logic Controllers: Introduction, Parts of a PLC, Principles of Operation, Modifying the Operation, PLCs versus Computers, PLC Size and Application. PLC Hardware Components: The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications, The Central Processing UNIT (CPU), Memory Design, Memory Types, Programming Terminal Devices, Recording and Retrieving Data, Human Machine Interfaces (HMIs).
Basics of PLC Programming: Processor Memory Organization, Program Scan, PLC Programming Languages, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions, Programming Examine If Closed and Examine If Open Instructions, Entering the Ladder Diagram, Modes of operation.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT – II

Developing Fundamental PLC Wiring Diagrams and Ladder Logic Programs: Electromagnetic Control Relays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Sensors, Output Control Devices, Seal-in Circuits, Latching Relays, Converting Relay Schematics into PLC Ladder Programs, Writing a Ladder Logic Program Directly from a Narrative Description. Programming Timers: Mechanical Timing Relays, Timer Instructions, On-Delay Timer Instruction, Off-Delay Timer Instruction, Retentive Timer, Cascading Timers. **SCADA Fundamentals:** Introduction, Open system: Need and advantages, Building blocks of SCADA systems, Remote terminal UNIT (RTU): Evolution of RTUs, Components of RTU, Communication subsystem, Logic subsystem, Termination subsystem, Testing and human-machine interface (HMI) subsystem, Power supplies, Advanced RTU functionalities, Intelligent electronic devices (IEDs), Data concentrators and merging UNITs, SCADA communication systems.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT – III

Master Station: Master station software components, Master station hardware components, Server systems in the master station, small, medium, and large master stations, Global positioning systems (GPS), Master station performance

Human-Machine Interface (HMI): HMI components, HMI software functionalities, Situational awareness, Intelligent alarm filtering: Need and technique, Alarm suppression techniques, Operator needs and requirements, SCADA Systems: Building the SCADA systems, legacy, hybrid, and new systems, Classification of SCADA systems, SCADA implementation: A laboratory model: The SCADA laboratory, System hardware, System software, SCADA lab field design.

9 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

Course Outcome (Course Skill Set)

At the end of the course the student will be able to :
1. Explain the principles of operation, hardware components and applications of PLC
2. Develop Fundamental PLC Wiring Diagrams and Ladder Logic Programs
3. Explain the building blocks and fundamentals of SCADA system
4. Explain the master station software and hardware components and server system
5. Design Human-Machine Interface (HMI) for a control application

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

MSE I	20 Marks
MSE II	20 Marks
Task	10 Marks
Total	50 Marks

Semester End Examination:

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**.

Suggested Learning Resources:

TEXTBOOKS:
1. "Programmable Logic Controllers And Industrial Automation An Introduction" by Madhuchhanda Mitra, Penram International Publishing, 2008
2. Ronald L Krutz, "Securing SCADA System", Wiley Publication, 2005
3. Gary Dunning," Introduction to Programmable Logic Controllers", Thomson, 2nd Edition.
4. John W Webb, Ronald A Reis,"Programmable Logic Controllers: Principles and Application", PHI Learning, Newdelhi, 5 th Edition.
5. Stuart A Boyer, "SCADA Supervisory Control and Data Acqusition", ISA, 4 th Revised edition
6. SCADA Supervisory Control and Data Acquisition, Stuart A Boyer, ISA, 4th Revised edition 1993

Web links and Video Lectures (e-Resources):
- https://nptel.ac.in/courses/108/105/108105088/

  Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
- Virtual Lab link- https://plc-coep.vlabs.ac.in/
- https://new.abb.com/plc
- https://new.siemens.com/global/en/products/automation/industry-software/automation- software/scada.html

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI641 / PLC and SCADA															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI641.1	2	2	2	2	2	-	-	-	-	-	-	2	3	2	3
C-21RI641.2	2	2	2	2	2	-	-	-	-	-	-	2	3	2	3
C-21RI641.3	2	2	2	2	2	-	-	-	-	-	-	2	3	2	3
C-21RI641.4	2	2	2	2	2	-	-	-	-	-	-	2	3	2	3
C-21RI641.5	2	2	2	2	2	-	-	-	-	-	-	2	3	2	3

1: 1ow   2: Medium   3: High

COMPUTER VISION			
Course Code	21RI642	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

- Understand digital image formation and process image using various transformation filtering, enhancement and histogram processing.
- Understand depth information and tracking object through multi-camera views.
- Understand feature extraction and image segmentation techniques
- Know the clustering and classification techniques to analyse patterns
- Tracking of an object through image sequence using motion analysis and estimating the shape from texture, color, motion and edges

UNIT – I

Digital Image Formation and low-level processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Restoration.

Depth estimation and Multi-camera views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT – II

Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT – III

Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Shape from X: Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.   **09 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation

Course Outcome (Course Skill Set)

At the end of the course the student will be able to :
1. Create image, apply various transformations and enhancement of image.
2. Make use of geometric camera models and multiple view geometry.
3. Apply various filtering techniques for feature extraction of image.
4. Apply algorithms for image segmentation and pattern recognition.
5. Apply different methods for motion analysis and shape estimation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

MSE I	20 Marks
MSE II	20 Marks
Task	10 Marks
Total	50 Marks

Semester End Examination:

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**.

Suggested Learning Resources:

TEXTBOOKS:
1. Computer Vision: Algorithms and Applications, Richard Szeliski, Microsoft Research, Electronic draft (2010).
2. Computer Vision: A Modern Approach, David A. Forsyth & Jean Ponce, Prentice Hall; 2 edition (2011)
3. Multiple View Geometry in Computer Vision, Hartley & Zisserman, Cambridge University Press; 2 edition (2004)
4. Machine vision, Jain, Ramesh and Rangachar Kasturi and Brian G. Schunck; McGraw-Hill, Edition-1995.
5. Introductory computer vision and image processing, Low, Adrian; McGraw-Hill, Edition-1991.
6. Digital image processing, Gonzalez, Rafael C. and Richard E. Woods; Addison-Wesley, Edition: 3rd, Year:1998.

Web links and Video Lectures (e-Resources):
- https://nptel.ac.in/courses/106/105/106105216/
- http://www.cse.iitm.ac.in/~vplab/computer_vision.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
- https://cloud.google.com/vision

COURSE ARTICULATION MATRIX:

Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Code / Name : 21RI642 / Computer Vision															
C-21RI642.1	3	3	3	2	3	-	-	-	-	-	-	3	2	3	2
C-21RI642.2	3	3	3	2	3	-	-	-	-	-	-	3	2	3	2
C-21RI642.3	3	3	3	2	3	-	-	-	-	-	-	3	2	3	2
C-21RI642.4	3	3	3	2	3	-	-	-	-	-	-	3	2	3	2
C-21RI642.5	3	3	3	2	3	-	-	-	-	-	-	3	2	3	2

1: 1ow   2: Medium   3: High

INTRODUCTION TO MATLAB PROGRAMMING

Course Code	21RI643	**CIE Marks**	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	**SEE Marks**	50
Total Hours of Pedagogy	40	**Total Marks**	100
Credits	03	**Exam Hours**	03

Course Learning Objectives:
- Explain the main features of the MATLAB program development environment to enable their usage in the simple engineering problems.
- Implement simple mathematical functions/equations in numerical computing environment such as MATLAB
- Able to program scripts and functions using the MATLAB development environment.
- Create and control simple plot and user-interface graphics objects in MATLAB
- Apply numeric techniques and computer simulations to solve engineering-related problems.

UNIT – I

MATLAB Basics: The MATLAB environment - Basic computer programming - Variables and constants, operators. Array operations in MATLAB, Loops and Execution Control, MATLAB Files-scripts and functions (m-files), Reading and writing data, file handling - Personalized functions - Toolbox structure, Plotting and Output

Errors and Approximations: Errors in Numerical Computation, Truncation Errors and Taylors Series, Round-Off Errors; and Iterative Methods, Step-wise Methods and Error Propagation.

Numerical Differentiation and Integration: Differentiation in Single Variable, Higher Order Differentiation Formulae, Partial Differentials , Numerical Integration, Multiple Applications of Integration Formulae, In-Built MATLAB Integration Functions   **15 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT – II

Linear Equations : Basics of Linear Algebra, Gauss Elimination and Back-Substitution, LU Decomposition and Partial Pivoting, Gauss Siedel Method

Nonlinear Equations in Single Variable, Using MATLAB command fzero, Fixed Point Iteration in Single Variable, Newton-Raphson (single variable), Using MATLAB command fsolve (multi-variable), Newton-Raphson (multi Variable)

Regression and Interpolation : Introduction, Linear Least Squares Regression, Nonlinear and Functional Regression, Interpolation Functions in MATLAB, Tutorial: How to do linear and nonlinear regression   **15 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT – III

Data analysis in MATLAB: Data Representation, Statistical Data Analysis, Data Visualization, Dimensionality Reduction , Data Classification, Data Prediction , Loading and Inspecting Datasets, Detecting Outliers, Histogram plots, Scatter plots, PCA.
Image Analysis in Matlab : Image Representation, Image Resampling, Image Intensity & Color Distributions, Image Filtering, Image Segmentation. Cropping, Color Images, Motion, Convex Hull, Dilation and Erosion.
Signal Analysis in Matlab: Signals as Time Dependent Data, Signal Interpolation. Signal Frequency Analysis, Sampling and Aliasing.   **9 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation

Course Outcomes (Course Skill Set)

At the end of the course the student will be able to :
1. Explain the main features of the MATLAB program development environment to enable their usage in the simple engineering problems.
2. Implement simple mathematical functions/equations in numerical computing environment such as MATLAB
3. Able to program scripts and functions using the MATLAB development environment.
4. Create and control simple plot and user-interface graphics objects in MATLAB
5. Apply numeric techniques and computer simulations to solve engineering-related problems

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

MSE I	20 Marks
MSE II	20 Marks
Task	10 Marks
Total	50 Marks

Semester End Examination:
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**.

Suggested Learning Resources:

TEXTBOOKS:

1. Mastering Matlab, Duane C. Hanselman, Bruce L. Littlefield, Pearson1st Edition, 2011
2. Stephen J. Chapman, Essentials of MATLAB Programming, Published By Cengage Learning, 2nd Edition, 2009
3. MATLAB and its Applications in Engineering, Raj Kumar Bansal, Ashok kumar Goel, Pearson 2016
4. Getting Started with MATLAB A Quick Introduction for Scientists and Engineers, Rudra Pratap Oxford, 7th Edition, 2010

Web links and Video Lectures (e-Resources):
- https://www.coursera.org/learn/matlab
- https://nptel.ac.in/courses/103/106/103106118/
- https://ocw.mit.edu/courses/mathematics/18-s997-introduction-to-matlab-programming-fall-2011/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
• https://in.mathworks.com/help/examples.html?s_tid=CRUX_topnav

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI643 / Introduction to MATLab Programming															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI643.1	3	2	3	3	3	-	-	-	-	-	-	3	3	2	3
C-21RI643.2	3	2	3	3	3	-	-	-	-	-	-	3	3	2	3
C-21RI643.3	3	2	3	3	3	-	-	-	-	-	-	3	3	2	3
C-21RI643.4	3	2	3	3	3	-	-	-	-	-	-	3	3	2	3
C-21RI643.5	3	2	3	3	3	-	-	-	-	-	-	3	3	2	3

1: 1ow   2: Medium   3: High

AUTONOMOUS VEHICLES			
Course Code	21RI644	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:
- Introduce the fundamental aspects of Autonomous Vehicles.
- Gain Knowledge about the Sensing Technology and Algorithms applied in Autonomous vehicles.
- Understand the fundamentals of car technology.
- Understand the Connectivity Aspects and the issues involved in driverless cars.
- Understand the aspects related to Computer Vision and Deep Learning for Autonomous Vehicles

UNIT – I

Introduction: Evolution of Automotive Electronics -Basic Control System Theory applied to Automobiles-Overview of the Operation of ECUs -Infotainment, Body, Chassis, and Powertrain Electronics-Advanced Driver Assistance Systems-Autonomous Vehicles.

Sensor Technology for Autonomous Vehicles: Basics of Radar Technology and Systems -Ultrasonic Sonar Systems-LIDAR Sensor Technology and Systems -Camera Technology -Night Vision Technology -Use of Sensor Data Fusion-Kalman Filters.   **15 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT – II

Connected Car Technology: Connectivity Fundamentals -DSRC (Direct Short-Range Communication) -Vehicle-to- Vehicle Technology and Applications -Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications -Security Issues.

Autonomous Vehicle Technology: Driverless Car Technology-Different Levels of Automation -Localization -Path Planning. Controllers to Actuate a Vehicle -PID Controllers -Model Predictive Controllers, ROS Framework.
15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT – III
Computer Vision and Deep Learning for Autonomous Vehicles: Computer Vision Fundamentals -Advanced Computer Vision -Neural Networks for Image Processing **Autonomous Vehicles' Biggest Challenges:** Technical Issues, Security Issues, Moral and Legal Issues. **09 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation

Course Outcome (Course Skill Set)

At the end of the course the student will be able to :
1. Explain the evolution of Automotive Electronics and the operation of ECUs.
2. Compare the different type of sensing mechanisms involved in Autonomous Vehicles.
3. Summarize the aspects of connectivity fundamentals existing in a driverless car.
4. Identify the different levels of automation involved in an Autonomous Vehicle.
5. Discuss about the use of computer vision in vehicles along with its challenges.

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

MSE I	20 Marks
MSE II	20 Marks
Task	10 Marks
Total	50 Marks

Semester End Examination:
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**.

Suggested Learning Resources:

TEXTBOOKS:
1. Autonomous Intelligent Vehicles: Theory, Algorithms and Implementation, Hong Cheng Springer, 2011
2. Understanding Automotive Electronics, Williams. B. Ribbens, Elsevier Inc 7th Edn. 2012
3. Creating Autonomous Vehicle Systems, Shaoshan Liu, Liyun Li, Morgan and Claypool Publishers
4. Autonomous Driving: Technical, Legal and Social Aspects , Marcus Maurer, J. Christian Gerde, Springer, 2016
5. Autonomous Vehicles for Safer Driving, Ronald. K. Jurgen, SAE International, 2013

Autonomous Vehicle Technology: A Guide for Policymakers, James Anderson, KalraNidhi, Karlyn Stanly, Rand Co, 2014

1. **Web links and Video Lectures (e-Resources):**
   - https://www.coursera.org/specializations/self-driving-cars
   - https://www.udacity.com/course/self-driving-car-fundamentals-featuring-apollo--ud0419

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
   - https://waymo.com/

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI644 / Autonomous Vehicles															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI644.1	2	2	2	2	3	-	-	-	-	-	-	3	2	2	2
C-21RI644.2	2	2	2	2	3	-	-	-	-	-	-	3	2	2	2
C-21RI644.3	2	2	2	2	3	-	-	-	-	-	-	3	2	2	2
C-21RI644.4	2	2	2	2	3	-	-	-	-	-	-	3	2	2	2
C-21RI644.5	2	2	2	2	3	-	-	-	-	-	-	3	2	2	2

1: 1ow   2: Medium   3: High

VIRTUAL INSTRUMENTATION			
Course Code	21RI645	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:
- Describe virtual instrumentation concepts.
- Describe data acquisition methodologies
- Describe PC Buses used in virtual instrumentation systems.
- Solve simple VI design problems using the tools of VI software.
- Apply the concept of VI for data acquisition and control.

UNIT – I

Virtual Instrumentation - Definition and Flexibility - Block diagram and Architecture for Virtual Instruments versus Traditional Instruments Instrumentation -VI Programming techniques - VI, sub VI, Loop and Charts, Arrays, Clusters and Graphs, Case and Sequence Structures, Formula nodes, String and File Input / Output.

A/D and D/A converters, Plug-in Analog Input / Output cards – Digital Input and Output Cards, Organization of the DAQ VI system – Opto-isolation – Performing analog input and analog output – Scanning multiple analog channels – Issues involved in selection of Data acquisition cards – Data acquisition modules with serial communication – Design of digital voltmeter with transducer input –Timers and Counters.   **15 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation, Demonstration of VI using LABVIEW Software

UNIT – II

Introduction to PC Buses – Local buses: - ISA, PCI, RS232, RS422 and RS485 – Interface Buses:- USB, PCMCIA, VXI,SCXI and PXI –Instrumentation Buses :- Modbus and GPIB – Networked busses – ISO/OSI Reference model, Ethernet and TCP/ IP Protocols.

Designs using VI Software - ON/OFF controller – Proportional controller – Modeling and basic control of level and reactor processes – Case studies on development of HMI, SCADA in VI.   **15 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation, Demonstration of Data acquisition and signal generation using LABVIEW Software

UNIT – III
PC architecture, current trends, operating system requirements, PC based instrumentation, analog and digital interfaces, PXI and SCXI main frame - modular instruments – Transducers – power, speed and timing considerations.   **9 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation, Demonstration of VI using LABVIEW Software

Course Outcome (Course Skill Set)

At the end of the course the student will be able to :
1. Explain virtual instrumentation and programming concepts.
2. Explain data acquisition methodologies for Virtual Instrumentation
3. Explain PC Buses used in virtual instrumentation systems.
4. Solve simple VI design problems using the tools of VI software.
5. Explain the implementation methods for instrumentation and the basic concepts of interfacing of VI.

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

MSE I	20 Marks
MSE II	20 Marks
Task	10 Marks
Total	50 Marks

Semester End Examination:
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**.

Suggested Learning Resources:

TEXTBOOKS:
1. LabVIEW Graphical Programming, Gary W. Johnson, Richard Jennings, McGraw-Hill Professional Publishing, 3rd edition, 2001
2. Lab view for Everyonell, Lisa K Wells, Prentice Hall of India. 3rd edition, 2006
3. Sensor, transducers and Lab view, Barry Paton, Prentice Hall of India, 2000.
4. Computer buses, Buchanan, W, CRC Press 2000

Web links and Video Lectures (e-Resources):
- https://www.ni.com/ (website)

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
- https://www.ni.com/en-in/innovations/white-papers/06/virtual-instrumentation.html

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI645 / Virtual Instrumentation															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI645.1	2	2	2	2	3	-	-	-	-	-	-	3	3	2	3
C-21RI645.2	2	2	2	2	3	-	-	-	-	-	-	3	3	2	3
C-21RI645.3	2	2	2	2	3	-	-	-	-	-	-	3	3	2	3
C-21RI645.4	2	2	2	2	3	-	-	-	-	-	-	3	3	2	3
C-21RI645.5	2	2	2	2	3	-	-	-	-	-	-	3	3	2	3

1: 1ow   2: Medium   3: High

Open Elective Courses-I

PLC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS

Course Code	21RI651	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:
- To understand the fundamentals of fluid power transmission systems
- To design various hydraulic system components.
- To design various pneumatic system components.
- Learn various types of hydraulic and pneumatic power circuits.
- Learn various types of applications in fluid power circuits.

UNIT – I

FLUID POWER SYSTEMS AND FUNDAMENTALS: Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, General types of fluids - Properties of hydraulic fluids -Fluid power symbols. Basics of Hydraulics-Applications of Pascal's
HYDRAULIC SYSTEM COMPONENTS: Sources of Hydraulic Power: Pumping theory - Pump classification - construction and working of pumps - Variable displacement pumps, pump performance. Actuators: Linear hydraulic actuators-Single acting and double acting cylinders, Rotary actuators - Fluid motors.
Control Components: Direction control valve - Valve terminology - Various center positions. Shuttle valve - checkvalve - pressure control valve - pressure reducing valve, sequence valve. Flow control valves - Fixed and adjustable Safety valves.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT – II

PNEUMATIC SYSTEM COMPONENTS: Pneumatic Components: Properties of air. Compressors. FRL UNIT -Air control valves, Quick exhaust valves and pneumatic actuators- cylinders, air motors. Basics of low cost automation.

FLUIDICS & PNEUMATIC CIRCUIT DESIGN: Fluidics - Introduction to fluidic devices, simple circuits Introduction to Electro Hydraulic Pneumatic logic circuits, PLC applications in fluid power control, Sequential circuit design for simple applications using classic, cascade, step counter, logic with Karnaugh- Veitch Mapping and combinational circuit design methods.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation, Demonstration of Hydraulic Components

UNIT – III

FLUID POWER CIRCUITS: Speed control circuits, synchronizing circuit, Pneumo hydraulic circuit, Accumulators and Intensifiers-Accumulator circuits, Intensifier circuits. Servo systems - Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Deceleration circuit, hydrostatics transmission circuits, control circuits for reciprocating drives in machine tools, Material handling equipments. Fluid power circuits; failure and troubleshooting.

9 Hours

Pedagogy	Chalk and talk method, Power Point Presentation, Demonstration of Pneumatic Components

Course Outcome (Course Skill Set)

At the end of the course the student will be able to :
1. Compare the basics of hydraulics to the performance of fluid power systems
2. Explain the working principle of hydraulic systems including pumps and control components.
3. Explain the working principle of pneumatic systems and their components.
4. Design various types of hydraulic and pneumatic power circuits.
5. Design various types of applications in fluid power circuits.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

MSE I	20 Marks
MSE II	20 Marks
Task	10 Marks
Total	50 Marks

Semester End Examination:

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**.

Suggested Learning Resources:

TEXTBOOKS:
1. Majumdar S.R., "Pneumatic systems - Principles and maintenance", Tata McGraw Hill, 2008
2. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2009.
3. Majumdar S.R., "Oil Hydraulics", Tata McGraw-Hill, 2000.
4. Harry L. Stevart D.B, "Practical guide to fluid power", Taraoeala sons and Port Ltd.Broadey, 2010.
5. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 2011.
6. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 2011.

Web links and Video Lectures (e-Resources):
• https://nptel.ac.in/courses/108/105/108105088/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
  • https://plc-coep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical%20Engineering
  • http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/COEP_KNOWLEDGE_SEEKERS/labs/exp1/theory.html

COURSE ARTICULATION MATRIX:

Course Code / Name : 21RI651 / PLC Control of Hydraulic and Pneumatic Circuits															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21RI651.1	3	2	3	2	3	-	-	-	-	-	-	3	3	2	3
C-21RI651.2	3	2	3	2	3	-	-	-	-	-	-	3	3	2	3
C-21RI651.3	3	2	3	2	3	-	-	-	-	-	-	3	3	2	3
C-21RI651.4	3	2	3	2	3	-	-	-	-	-	-	3	3	2	3
C-21RI651.5	3	2	3	2	3	-	-	-	-	-	-	3	3	2	3

1: 1ow   2: Medium   3: High

OPEN ELECTIVE (VI Semester) - 2023-2024

Sl. No.	Code	Name
1.	21MA8X02	Linear Algebra (for all except CS, IS, EC, CCE & AIML)
2.	21HU8X03	Intellectual property rights (for all)
3.	21CV8X07	Environment Impact Assessment (for all except Civil)
4.	21ME8X08	Industrial Pollution Control (for all except Mechanical)
5.	21HU8X24	Professional and Cognitive Communique (for all)
6.	21ME8X28	Operations Management and Entrepreneurship (for all except Mechanical)
7.	21IS8X38	Introduction to Python Programming (for all except CS & IS)
8.	21BT8X40	Bio Fuel Engineering (for all except BT)
9.	21BT8X42	Solid Waste Management (for all except BT & Civil)
10.	21EC8X59	PCB Design (For all except E&C)
11.	21ME8X63	Innovation & Entrepreneurship (for all)
12.	21HU8X68	Introduction to Yoga (The classes will be conducted from 7.00 a.m. to 8.00 a.m. Those who are willing to come at 7.00 a.m. should only register)
13.	21HU8X70	Overview of Indian Culture and Arts (for all)
14.	21HU8X71	Principles to Physical Education (The classes will be conducted from 5.30 p.m. to 6.30 p.m. Those who are willing to come at 5.30 p.m. should only register)
15.	21HU8X72	Introduction to Japanese language (Students with no backlogs, CGPA should be above 7.0 & who opt to get placed in Japanese companies in Japan/India are eligible to register)
16.	21HU8X74	Introduction to German Language (for all)
17.	21ME8X75	Sustainable Development Goals (for all)
18.	21IS8X76	Web Technologies (for all except CS & IS)
19.	21CS8X77	Programming in Java (for all except EC,CS & IS)
21.	21CS8X78	Data Structures & Algorithms (for all except EC,CS & IS)
21.	21EE8X79	Electric Vehicle Technology (for all except EE)
22.	21HU8X81	National Cadet Corps: Organization, Functions & Capabilities (for only NCC Cadet Students)
23.	21EC8X82	Fundamentals of Image Processing – a practical approach (Only for CV, ME & BT)
24.	21HU8X86	Introduction to Yakshagana (for all - who are familiar with kannada Language)
25.	21ME8X88	Marketing Management (for all except Mechanical)

LINEAR ALGEBRA			
Course Code	**21MA8X02**	**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 the students to
1. Understand the concepts of vectors, bases.
2. Determine the kernel, range, rank, and nullity of a linear transformation and apply them suitably in their field of study.
3. Find the canonical forms and appraise its importance in various fields.
4. Make use of Gram-Schmidt process to produce an orthonormal basis.
5. Learn the concepts of singular value decomposition and PCA.

UNIT - I

Vector spaces

Vector spaces, subspaces, bases and dimensions, coordinate vecotrs, null spaces and column spaces of the matrices.

Linear Transformations

15 Hours

UNIT - II

Canonical Forms

Review of characteristic values, similarity of matrices, Cayley Hamilton theorem, annihilating polynomials, invariant subspaces, Jordan and rational canonical forms.

Inner Product Spaces

Inner products; inner product spaces, orthogonal sets and projections, Gram-Schmidt process, QR-factorization, Least-squares problems.

15 Hours

UNIT - III

Symmetric Matrices and Quadratic Forms:

Diagonalization, quadratic forms, constrained optimization, singular value decomposition and principal component analysis. Applications to linear recurrence relations.

09 Hours

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

1.	Interpret vectors in two and three-dimensional spaces both algebraically and geometrically.
2.	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.
3.	Understand the concepts of Jordan and rational canonical forms.
4.	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.
5.	**Apply techniques of constrained optimization singular value decomposition and PCA for problems arising in various engineering fields.**

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2										
CO2	2	2										
CO3	3	1										
CO4	3	2										
CO5	3	2										

1: Low 2: Medium 3: High

Mode of Teaching and Learning:
Class room teaching.
Use of mathematical softwares (such as MATLAB, MATHEMATICA, SAGE, ETC.) as teaching aid.

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student must obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:	
1.	Methods recommended: Two Tests (80%), Written Quiz (10%) and module assignments (10%).
2.	The class teacher must decide the topic for closed book test and Written Quiz. In the beginning only teacher must announce the methods of CIE for the subject.
Semester End Examination:	
	There will be **8** questions of **21** 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.	**Kenneth Hoffman and Ray Kunze, "Linear Algebra," 2nd edition, Pearson Education (Asia) Pte. Ltd, 2104.**
2.	David C.Lay, "Linear Algebra and its Applications",3rd edition, Pearson Education (Asia) Pte. Ltd, 2105.
REFERENCE BOOKS:	
1.	M. Artin , Algebra Prentice Hall of India.2104.
2.	Gilbert Strang, "Linear Algebra and its Applications", 4th edition, Thomson Learning Asia, 2103.
3.	Bernard Kolman and David R. Hill, "Introductory Linear Algebra with Applications", Pearson Education (Asia) Pte.Ltd 7th edition ,2103.
4.	Sheldon Axler, "Linear Algebra Done Right", Springer International Publication, Third Edition,2115.

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INTELLECTUAL PROPERTY RIGHTS

Course Code	21HU8X03	**Course Type**	OEC
Teaching Hours/Week (L:T:P: S)	3:0:0:0	**Credits**	03
Total Teaching Hours	39+0+0	**CIE + SEE Marks**	50+50
Teaching Department: Humanities			

Course Learning Objectives:	
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
Agreements and Treaties History - General Agreement on Trade and Tariff (GATT). Indian Position vis-a-vis WTO and Strategies; TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; International convention relating to Intellectual Property - Establishment of WIPO - Mission and Activities – Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments – Patent (Amendment) Rules, 2117	8

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
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

UNIT - III	
Case Studies: Patents: Biological Cases - i) Basmati rice ii) Turmeric iii) Neem; 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

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

1.	Have a General understanding of the Intellectual Property Rights.
2.	Have awareness of different forms of intellectual property rights, national and international IPR related legislations.
3.	Have a 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.
4.	Acquire Knowledge of National and International Trade Agreements and Agencies functioning in relation to intellectual property rights
5.	Be aware and have a general understanding of patenting procedures and licensing.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2
CO1		3	3	2		3			2	2		3		
CO2	2	2	3			3		3	1	1	2	2		
CO3	2			2		3			2	2	2	3		
CO4			1	1		3			1	2		3		
CO5	3	2	1			3			3	1		2		

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2107
2.	Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2107
3.	Subbaram N.R. "Handbook of Indian Patent Law and Practice", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.
4.	Eli Whitney, United States Patent Number: 72X, Cotton Gin, March 14, 1794.
5.	Intellectual Property Today: Volume 8, No. 5, May 2101,
6.	WTO and International Trade by M B Rao. Vikas Publishing House Pvt. Ltd.
7.	Correa, Carlos M. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and

8.	Wadehra, B. L. Law relating to patents, trademarks, copyright designs & geographical indications 2 ed. Universal Law Publishing 2100
9.	Sinha, Prabhas Chandra Encyclopedia of Intellectual Property Rights, 3 Vols. Eastern Book Corporation, 2106.
10.	"Practical Approach to Intellectual Property Rights"; Rachna Singh Puri and Arvind Vishwanathan, I. K. International Publishing House Pvt. Ltd.
E-RESOURCES:	
1.	http://www.w3.org/IPR/
2.	http://www.wipo.int/portal/index.html.en
3.	http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
4.	www.patentoffice.nic.in
5.	www.iprlawindia.org/

Note: first row shown is continuation of item 7 "policy options, Zed Books, New York 2100".

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ENVIRONMENTAL IMPACT ASSESSMENT			
Course Code	21CV8X07	**CIE Marks**	50
Teaching Hours/Week (L:T:P)	3:0:0	**SEE Marks**	50
Total Hours	39	**Credits**	03

<u>**Course Learning Objectives:**</u>

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

<u>**Course Outcomes:**</u>
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 :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1				2	3	2					2	3	
CO2	1	1				2	3	2					2	3	
CO3	1	1				2	3	2					2	3	
CO4	1	1				2	3	2		3			2	3	
CO5	1	1		3		2	3	2				3	2	3	

Note:- 1:Low   2:Medium   3: High

TEXTBOOKS:
1. Noble, L. 2110. Introduction to environmental impact assessment. A Guide to Principles and Practice. 2nd edition. Oxford University Press, Don Mills, Ontario.
2. Larry W. Canter, Environmental Impact Assessment, McGraw Hill Inc. Singapore, 1996

ADDITIONAL REFERENCE MATERIALS
1. Morris and Therivel, 2109. Methods of Environmental Impact Assessment, 3rd edition. New York, NY: Routledge.
2. Hanna, K.S. 2109. Environmental impact assessment. Practice and Participation. 2nd edition. Oxford, University Press, Don Mills, Ontario.

NPTEL SOURCES
http://nptel.ac.in/courses/121108004/
http://nptel.ac.in/courses/121108004/module3/lecture3.pdf

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INDUSTRIAL POLLUTION CONTROL			
Course Code	21ME8X08	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

15 Hours

	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..

15 Hours

	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

CO 1	Identify the various types of pollutants and distinguish between them with regards to Particulate matters and AQI.
CO 2	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.
CO 3	Explain the Particulates and fly ash separation techniques, compare and Interpret their efficiency.
CO 4	Illustrate Formation, measurement and control techniques for Smoke and gaseous pollutants
CO 5	Identify Effects of water, soil, plastics and odor pollution on environmental Pollution and explain the Legal aspects of pollution control.

TEXTBOOKS:
1. "Environmental Pollution Control Engineering, *Wiley Eastern Ltd.,*
2. "Introduction to Environmental Engineering & Science", Gilbert M Masters, PHI,1995
3. "Environmental Pollution Control Engineering, *C. S RAO New Age Int.*

REFERENCE BOOKS:
1. *"Air Pollution"*, Henry C. Perkins, Mc-Graw Hill, 1974.
2. *"Air Pollution control"*, W. L. Faith, *John Wiley*

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

Course Articulation Matrix

Course Code / Name : 21ME8X08/ Industrial Pollution Control														
Course Outcomes (CO)	**Program Outcomes (PO)**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C-21ME8X08.1	2								1	1		1		
C-21ME8X08.2	2								1	1		1		
C-21ME8X08.3	2								1	1		1		
C-21ME8X08.4	2								1	1		1		
C-21ME8X08.5	2								1	1		1		

1: Low   2: Medium   3: High

There will be **8** questions of **21** 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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PROFESSIONAL & COGNITIVE COMMUNIQUÉ			
Course Code	21HU8X24	**Course Type**	OEC
Teaching Hours/Week (L:T:P: S)	3:0:0:0	**Credits**	03
Total Teaching Hours	39+0+0	**CIE + SEE Marks**	50+50
Teaching Department: Humanities			

Course Learning Objectives:

1.	To Problematize Commonsense & Apply Critical thinking skills
2.	Comprehend etiquettes and manners in different situations
3.	Be gender sensitive in both offline and online behavior
4.	Exhibit better comprehension of the social implications of human body
5.	Understand the importance of reading and writing skills

UNIT - I

Common sense and Emotional Intelligence

Common sense, Commonsensical Consensus, Critical thinking, Unsettling commonsensical Consensus, Role of language in Common sense and Critical Thinking; Nature & Functions of Emotional Intelligence, Emotions, Intelligence and Creativity, Growth of Emotional Intelligence

15

Etiquettes & Workplace

Etiquette, Workplace Etiquettes, Workplace Readiness Skills, Significance of Cross-Cultural Understanding; Cultural Sensitivity, Impact of social media in Workplace

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

15

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

UNIT - III

Writing

Types of Writing, Note Taking Methods, Plagiarism

Reading

Styles of Reading, Types of Reading, Scanning, Skimming

9

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

1.	Problematize Commonsense & Apply Critical thinking skills
2.	Comprehend etiquettes and manners in different situations
3.	Be gender sensitive in both offline and online behavior
4.	Exhibit better comprehension of the social implications of human body
5.	Understand the importance of reading and writing skills

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓	
↓ Course Outcomes													1	2
CO1		3							3	3		3		
CO2		2					3		2	3		2		
CO3		3							2	2		3		
CO4		3							2	2		3		
CO5		2							3	3		2		

        1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Geetha.V. Gender. Kolkatta: Web Impressions, 2109.
2.	Bailey, Jane, et al. "Negotiating with Gender Stereotypes On Social Networking Sites: From "Bicycle Face" to Facebook." Journal of Communication Enquiry 37.2 (2113): 91-112.
3.	Barry, Peter. Beginning Theory. New Delhi: Viva Books, 2110.
4.	Berger, John. Ways of Seeing. London: Penguin Books, 1977.
5.	Cranny-Francis, Anny, et al. Gender Studies: Terms and Debates. New York: Palgrave Macmillan, 2103.
6.	Gauntlett, David. Media, Gender and Identity: An Introduction. London: Routledge, 2108
7.	Pilcher, Jane, and Imelda Whelehan. 50 Key Concepts in Gender Studies. London: Sage, 2104. Print.
8.	Jeanne, Haraway Donna. Simians, Cyborgs, and Women. London: Free Association Books, 1991. Web.
9.	Koskela, Hille. "Webcams, TV Shows and Mobile Phones: Empowering Exhibitionism." Surveillance & Society 2.3 (2104): 199-215.Web.

E-RESOURCES:

1.	http://www.cyberpsychology.eu/view.php?cisloclanku=2109061501/ >.
2.	http://www.surveillance-and-society.org/articles2(2)/webcams.pdf
3.	http://eprints.rclis.org/19790/>.

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OPERATIONS MANAGEMENT & ENTREPRENEURSHIP

Course code	**21ME8X28**	**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	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 to

Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP).

7 Hours

Introduction to Quality Concepts: The Meaning of Quality and Quality Improvement, Key dimensions of Quality, Concept of cost of quality. Customers' perception of quality.

TOTAL Quality Management: Definition, Principles of TQM, Gurus of TQM, Benefits of TQM.

Managing Quality: Quality circles, Continuous Improvement- Juran's Trilogy, PDSA cycle, Kaizen, 7 QC tools,

Philosophy of statistical process control and modeling process quality: Normal distribution tables, Finding the Z score, Central limit theorem, Chance and assignable causes of variation, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, warning limits)

9 Hours

UNIT – II

Control charts for variables: Control Charts for X-Bar and R- Charts, Type I and Type II errors, 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. Concept of Six sigma.

Introduction to reliability, Mean time to failure, Mean time between failures, Bath tub curve, Reliability of series and parallel systems, Numerical problems on the above topics.

8 Hours

Entrepreneurship: Concept of Entrepreneurship, Stages in entrepreneurial process, Role of entrepreneurs in Economic Development, Barriers to Entrepreneurship, Meaning of Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneurs, Intrapreneur - an emerging Class.

Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

Application of Operations Management concepts in Facility/ Business Location: General procedure for making locations decisions, Numerical Problems on application of Breakeven analysis and Transportation method to make location decisions.

8 Hours

UNIT – III

Small scale industries: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start and SSI, Government policy towards SSI; Different Policies of SSI, Impact of Liberalization, Privatization, Globalization on SSI. Effect of WTO/GATT on SSI, Supporting Agencies of Government for SSI, Ancillary Industry and Tiny Industry (Definition Only)

Institutional Support: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.

7 Hours

Course Outcomes (CO)

CO 1	Differentiate production and service systems. Discuss continuous and intermittent production systems with their advantages and disadvantages. Discuss CRM and ERP systems.
CO 2	Discuss Total Quality Management tools and methods. Solve problems on fundamentals of statistics and normal distribution.
CO 3	Draw and Analyze variable process control charts and determine process capability. Calculate reliability of series and parallel systems using the information on failure rate and time.
CO 4	Discuss entrepreneurship, characteristics of an entrepreneur and barriers to entrepreneurship. Discuss the elements of a project report and feasibility studies conducted in the project appraisal.
CO 5	Identify and differentiate the national and state level funding agencies. Discuss the effect of GATT and WTO on Indian economy.

TEXTBOOKS:

1. **Production / Operations Management**, Joseph G Monks, McGraw Hill Books
2. **Production and Operations Management**, William J Stevenson, Tata McGraw Hill, 8th Edition.
3. **Statistical Quality Control**: RC Gupta, Khanna Publishers, New Delhi, 2105.
4. **Total Quality Management**: Dale H. Besterfield, Pearson Education, 2103.
5. **Dynamics of Entrepreneurial Development & Management** –
   Vasant Desai – Himalaya Publishing House
6. **Entrepreneurship Development** – Poornima.M.Charantimath – Small Business Enterprises – Pearson Education – 2106 (2 & 4).

REFERENCE BOOKS:

1. **Statistical Quality Control:** E.L. Grant and R.S. Leavenworth, 7th edition, McGraw- Hill publisher.
2. **Statistical Process Control and Quality Improvement:** Gerald M. Smith, Pearson Prentice Hall. ISBN 0 – 13-049036-9.
3. **Statistical Quality Control for Manufacturing Managers:** W S Messina, Wiley & Sons, Inc. New York, 1987
4. **Statistical Quality Control:** Montgomery, Douglas, 5th Edition, John Wiley & Sons, Inc. 2105, Hoboken, NJ (ISBN 0-471-65631-3).
5. **Principles of Quality Control:** Jerry Banks, Wiley & Sons, Inc. New York.
6. **Entrepreneurship Development** – S.S.Khanka – S.Chand & Co.

MOOC/NPTEL Resources:

1. http://nptel.ac.in/courses/110105067/
2. https://www.edx.org/course/operations-management-iimbx-om101-1x

Course Articulation Matrix

Course Code / Name: 18ME8X28/ Operations Management & Entrepreneurship															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21ME8X28.1	3	1	0					1	1	1	1				
C-21ME8X28.2	1	2	0						1	1	3				
C-21ME8X28.3	2	2	0				1	0	1	1	3				
C-21ME8X28.4	3	1	0			1	0	1	1		2				
C-21ME8X28.5	1	1	0			1	1	1	1		3				

1: Low   2: Medium   3: High

Scheme of SEE Question Paper

There will be **8** questions of **21** 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 PYTHON PROGRAMMING			
Course Code	21IS8X38	**CIE Marks**	50
Teaching Hours/Week (L:T:P)	3:0:0	**SEE Marks**	50
Total Hours	39	**Credits**	03

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:

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C8X38.1	Demonstrate the basics of Python programming like data types and looping	L2
C8X38.2	Apply the basic data structures in solving the problems	L3
C8X38.3	Experiment with usage of functions in a given problem	L3
C8X38.4	Develop Objects by creating classes and apply object-oriented features	L3
C8X38.5	Develop applications in Python using File Programming &User Interface	L3

Table: Mapping of COs to PIs, POs and BTL			
Course Outcomes (COs)	**Program Outcomes (POs) Addressed**	**Performance Indicators (PI)**	**Bloom's Taxonomy Level (BTL)**
CO1	1,2,3	1.4.1,1.3.1,2.1.1,2.1.2,2.2.4,3.1.1	L2
CO2	1,2,3	1.4.1,1.3.1,2.3.1,3.1.1,3.2.2	L3
CO3	1,2,3	1.4.1,1.3.1,2.1.1,2.1.2,2.2.4,3.1.1,3.1.6,3.2.1,3.2.2	L3
CO4	1,2,3	1.4.1,1.3.1,2.1.1,2.1.2,2.2.4,3.1.1,3.1.6,3.2.1,3.2.2	L3
CO4	1,2,3	1.4.1,1.3.1,2.1.1,2.1.2,2.2.4,3.1.1,3.1.6,3.2.1,3.2.2	L3

Mapping Course Outcomes with Programme Outcomes:

POs COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C8X38.1	1	2	1											
C8X38.2	1	2	1										2	2
C8X38.3	1	2	2										2	3
C8X38.4	1	2	2										2	3
C8X38.5	1	2	2										2	3

(L/1=Low30%-49%,M/2=Medium50%-69%,H/3=High>70%)

TEXTBOOK:
1) Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2111, Cengage Learning, ISBN: 978-1111822705

SEE Question Paper Pattern:

There will be **8** questions of **21** 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.**

BIOFUEL ENGINEERING			
Course Code	21BT8X40	**CIE Marks**	50
Teaching Hours/Week (L:T:P)	3:0:0	**SEE Marks**	50
Total Hours	39	**Credits**	03

*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
Description and classification of Biofuels; Primary biomass: Plant materials-Woody biomass, Lignocellulosic and agroindustrial by-products, starchy and sugary crops. Secondary biomass: Waste residues and co-products-wood residues, animal waste, municipal solid waste. Biomass production for fuel – algal cultures, yeasts (Lipid and carbohydrate).
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

15 Hours

UNIT – II

BIOHYDROGEN AND MICROBIAL FUEL CELLS
Enzymes involved in H_2 Production; Photobiological H_2 Production: Biophotolysis and Photofermentation; H_2 Production by Fermentation: Biochemical Pathway, Batch Fermentation, Factors affecting H_2 production, Carbon sources, Detection and Quantification of H_2. 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.

15 Hours

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.

9 Hours

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:

CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1		M							L			
CO2		M							L			
CO3		M							L			
CO4		M							L			
CO5		M							L			

REFERENCE BOOKS:

1. Drapcho, C. M., Nhuan, N. P. and Walker, T. H. *Biofuels Engineering Process Technology,* Mc Graw Hill Publishers, New York, 2108.
2. Jonathan R.M, *Biofuels – Methods and Protocols (Methods in Molecular Biology Series),* Humana Press, New York, 2109.
3. Olsson L. (Ed.), *Biofuels (Advances in Biochemical Engineering/Biotechnology Series,* Springer-Verlag Publishers, Berlin, 2107.
4. Glazer, A. and Nikaido, H. *Microbial Biotechnology – Fundamentals of Applied Microbiology*, 2 Ed., Cambridge University Press, 2107.
5. Godfrey Boyle (Ed). *Renewable Energy- Power for sustainable future*, 3rd Ed. Oxford. 2112.
6. Ramachandran, T. V. *Management of municipal solid waste*. Environmental Engineering Series. Teri Press, 2116.

SEE QUESTION PAPER PATTERN:

Unit No.	I	II	III
Questions to ask (21 marks/Qn)	3	3	2
Questions to answer	2	2	1

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SOLID WASTE MANAGEMENT			
Course Code	21BT8X42	**CIE Marks**	50
Teaching Hours/Week (L:T:P)	3:0:0	**SEE Marks**	50
Total Hours	39	**Credits**	03

*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.

15 Hours

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.

16 Hours

UNIT – III

SOLID WASTE MANAGEMENT RULES AND PLANNING ISSUES
Legislative trends and impacts: Major legislations, Government agencies. Municipal Solid Waste Management Act (1999), Hazardous Wastes (Handling and Management) Rules, Biomedical Waste (Handling and Management) Rule (1998), e-Waste (Management and Handling) Rule 2111.
Planning and developing a site for solid waste management, Site Remediation: Assessment and Inspection, Remedial techniques, Siting guidelines.

8 Hours

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:

CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	L								L			
CO2	L	L				L	L		L			
CO3		M							L			
CO4		M				L	L		L			
CO5	L								L			L

REFERENCE BOOKS:
1. Tchobanaglous, G., Theisen, H. and Vigil, S. A. *Integrated Solid Waste Management,* McGraw – Hill. 1993.
2. Tchobanoglous, G., Thiesen, H., Ellasen, *Solid Waste Engineering Principles and Management*, McGraw – Hill, 1997.
3. Landrefh, R. E. And Rebers, P. A. Lewis, *Municipal Solid Wastes-Problems & Solutions*, 1997.
4. Bhide, A. D. and Sundaresan, B. B. *Solid Waste Management in Developing Countries*, Indian National Scientific Documentation Centre. New Delhi, 2100.

Unit No.	I	II	III
Questions to ask (21 marks/Qn)	3	3	2
Questions to answer	2	2	1

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PCB DESIGN			
Course Code	21EC8X59	**CIE Marks**	50
Teaching Hours/Week (L:T:P)	3:0:0	**SEE Marks**	50
Total Hours	39	**Credits**	03

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 filein 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.

Sl.No	Activity	Max. Marks
1	Creating schematic for a given circuit diagram	15
2	PCB Layout design	21
3	Setting up fabrication	15
Total		**50**

<u>**Course Outcomes:**</u>
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				
Course Code	**21ME8X63**	**CIE Marks**	**50**	
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**	
Total Hours	**39**	**Credits**	**03**	

<u>**Prerequisites:**</u>
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	**14 Hours**

Basic Concepts and Definitions: Technology - Technology Management – Invention – Creativity – Innovation - The Concept of Technological Innovation - Innovation Posture, Propensity and Performance - Innovation Measurement - Key factors linking creativity and innovation – Classifications of Innovations – Innovation Process.

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,	
CO 1	Describe technological innovation and its key features for business.
CO 2	Describe innovation management and difference between invention and innovation.
CO 3	Explain innovation as a management process, its management and perspectives. Understand Innovation management techniques.
CO 4	Explain innovation system, technology management and transfer.
CO 5	Explain technological entrepreneurship and institutional support.

TEXTBOOK:	
1	Carayannis, Elias G., Samara, Elpida T., Bakouros, Yannis L., "Innovation and Entrepreneurship Theory, Policy and Practice", Springer, 2115.

REFERENCE BOOKS:	
1	Dick Whittington, "Digital Innovation and Entrepreneurship", Cambridge University Press, 2118.

Course Articulation Matrix:

Course Code / Name : 21ME8X63/ INNOVATION AND ENTREPRENEURSHIP														
Course Outcomes (CO)	Program Outcomes (PO)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C-21ME8X63.1	3	2				1	1		1			1	3	1
C-21ME8X63.2	3	2				1	1		1			1	3	1
C-21ME8X63.3	2	2				1	1		1			1	3	1
C-21ME8X63.4	2	2				1	1		1			1	3	1
C-21ME8X63.5	3	2				1	1		1			1	3	1

1: Low   2: Medium   3: High

Scheme of SEE Question Paper

There will be **8** questions of **21** 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

Course Code:	21HU8X68	Course Type	OEC
Teaching Hours/Week (L:T:P: S)	3:0:0:0	Credits	03
Total Teaching Hours	39	CIE + SEE Marks	50+50

Teaching Department: Mechanical Engineering

Course Learning Objectives:

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.	To explain the Asanas and other Yogic practices
5.	To explain, how Yoga practices can be applied for overall improvement

UNIT – I

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: Asanas, Pranayama.	**09 Hours**

Classification of Yoga and Yogic texts:Yogasutra of Patanjali, Hatha yogic practices- Asanas, Pranayama, Dharana, Mudras and bandhas.	**07 Hours**

UNIT – II

Yoga and Health: Concept of health and Diseases-Yogic concept of body – pancakosaviveka, Concept of disease according to Yoga Vasistha.	**06 Hours**

Yogic concept of healthy living- rules & regulations, yogic diet, ahara, vihara. Yogic concept of holistic health.	**04 Hours**

Applied Yoga for elementary education:Personality development- physical level,mental level,emotional level. Specific guidelines and Yoga practices f**or** - Concentration development,Memory development	**04 Hours**

UNIT - III

Yoga and physical development: Mind-body, Meditation, Yogasanas and their types. Different Yoga practices and Benefits.	**05 Hours**

Specific guidelines and Yoga practices for – Flexibility, Stamina, Endurance (Surya Namaskara)	**04 Hours**

Course Outcomes: At the end of the course 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

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓	
↓ Course Outcomes													1	2
CO1						1			1			1		
CO2						1			1			3		
CO3						2			1			3		
CO4						3			2			3		
CO5						2			2			3		

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	B.K.S. Iyengar, "Light on Yoga: The Classic Guide to Yoga by the World's Foremost Authority", Thorsons publisher 2116.
2.	MakarandMadhukar Gore, "Anatomy and Physiology of Yogic Practices: Understanding of the Yogic Concepts and Physiological Mechanism of the Yogic Practices", MotilalBanarsidass Publishers; 6 edition (2116).
3.	Swami SatyanandaSaraswati, "Asana, Pranayama, Mudra and Bandha: 1", Yoga Publications Trust.

REFERENCE BOOKS:

| 1. | Science of Yoga: Understand the Anatomy and Physiology to Perfect Your Practice by Ann Swanson |
| 2. | Yoga for Everyone : 50 Poses For Every Type of Body by Dianne Bondy |

E Books / MOOCs/ NPTEL

| 1. | https://onlinecourses.swayam2.ac.in/aic19_ed29/preview |
| 2. | https://youtu.be/FMf3bPS5wDs |

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OVERVIEW OF INDIAN CULTURE AND ART			
Course Code	**21HU8X70**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Learning Objectives:

1.	To understand the relevance of Culture in Human Life, dynamism of Indian Culture and Arts through ages.
2.	To understand the local culture and its vibrancies.
3.	To develop awareness about Indian Society, Culture and Arts under Western rule.
4.	To comprehend different dimension and aspects of the Indian culture and arts.
5.	To appreciate cultural performances in India.

UNIT - I	
Knowing Culture What is Culture, Different aspects of Culture, Cultural expression, Importance of Culture	7
Influence of Culture Relationship of Culture with: Language, Religion and History, Gender	7

UNIT - II	
Media and Culture Role of News Papers, Indian Cinema, Music, Advertisements	7
Languages, Literature and Culture 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, Subaltern Literature	7

UNIT - III	
Arts and Culture Indian Theatre and Performing Arts, Ritual performances, and Tuluva cultural and ritual performances.	7
(Self-study Component) **Contribution of Indian History to Culture** Ancient India – Persian and Macedonian invasions and its impact on Indian Culture, Development of Culture and Arts during the Mauryan Empire (Ashoka), the Guptas, the South Indian Dynasties – the Cholas, Nalanda as a Centre of Learning. Medieval India – Life of People under Delhi Sultanate, Rise of Islam and Sufism, Political Scene of India, Bhakti Movement, Folk Arts, Rise of Modern Indian Languages. Modern India – British Ruling and its impact on Indian Culture, Social and Religious Reforms, Indian National Movement and Achievement of Independence.	4

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

1.	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.	Appreciate their own local culture from an academic perspective.
3.	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.
4.	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.
5.	Appreciate art performances in India which will enable them to get exposed to an artistic sphere, which eventually help them to be creative and imaginative.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2
CO1		1				3		3	3	1		3		
CO2				2		3		2	3	3		3		
CO3						3		1				1		
CO4						3		2	1	2		3		
CO5						3		3	3	3		2		

1: Low 2: Medium 3: High

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PRINCIPLES TO PHYSICAL EDUCATION			
Course Code	21HU8X71	**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. 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 FirstAid, Scope of FirstAid, 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
Leadership and Supervision – Leadership, Qualities of a good leader in Physical Education, Types of Leadership in Physical Education - 1. Teacher Leadership 2. Student Leadership.
Measurement & specification of various playing fields – Cricket, Volley Ball, Basket Ball, Badminton, Ball Badminton, Foot Ball, Hand Ball & their basic playing skills.

16 Hours

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.

Course Outcomes Mapping with Program Outcomes & PSO															
Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes														1	2
CO1						3			2	1		1			
CO2						3			2	1		1			
CO3						3			2	1		1			
CO4						3			2	1		1			
CO5						3			2	1		1			
1: Low 2: Medium 3: High															

TEXT AND REFERENCE BOOKS:
1. A. K. Uppal, "Physical Education and Health"
2. M. L. Kamlesh, "Fundamental Elements of physical Education",
3. Swami Ramdev, "Yog its philosophy and practice", Divya Prakashan
4. V. K. Sharma, "Health and Physical Education"

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INTRODUCTION TO JAPANESE LANGUAGE					
Course Code		21HU8X72	**Course Type**		OEC
Teaching Hours/Week (L:T:P: S)		3:0:0:0	**Credits**		03
Total Teaching Hours		39+0+0	**CIE + SEE Marks**		50+50

Teaching Department:

Course Objectives:

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	13

UNIT - II

(Lessons 7-13) Communication skills – Time, Addective, Seasons, Conversation, Q&A Hobby, 5-W/1-H, Entering School/Company, Body Parts, Colours, Features etc**.**	13

UNIT - III

(Lessons 14-21) Japanese Counting System, Birth/Death, Dialogs (Going to Party, Restaurant), My day, Success/Failure, Kanji Characters, and sentence making, Video Clips	13

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

1.	Understand Simple words, expressions and sentences, spoken slowly and distinctly
2.	Speak slowly and distinctly to comprehend
3.	Read and Understand common words and sentences
4.	Ask Basic questions and speak in simple sentences
5.	Write Hiragana/Katakana and Kanji (121) characters.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2
CO1						3			2	1		1		
CO2						3			2	1		1		
CO3						3			2	1		1		
CO4						3			2	1		1		
CO5						3			2	1		1		

1: Low 2: Medium 3: High

INTRODUCTION TO GERMAN LANGUAGE			
Course Code	**21HU8X74**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical

Course Objectives:

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.
2.	Differentiate between nomnative and akkusative cases with transitive and intransitive verbs, and negation with Kein/e/er
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.
4.	Differentiate preposition forms when used exclusively in akkusative or Dative forms or on combination of the two cases
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.

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 politischenKarte der Welt, Nationalitaeten und Spachen, Die Uhrzeit (The time) telling time and talking about daily routine, Tage der Woche, die Monate, die vierJahreszeiten, die Jahre
Mir gehtes gut: Asking people how they are, saying how you are, saying which cities and counries people come from, Language points: verb endings),
Wieschreibt 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 vierFälle (The four cases): Nominativ, Akkusativ, Dativ, Genitiv(Not in level A-1)
Deklination des bestimmtenArtikels der/die/das
Deklination des unbestimmtenArtikelsein/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(nominative 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.
(Nominative 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 siehteinHaus. ⬜ Negation ⬜ Peter siehtkeinHaus.
(Peter sees a house. ⬜ negation ⬜ Peter does not see a house.)

(With examples, writing and hearing exercises, and German to English Glossary as applicable)

13

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)

13

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 Personal pronomenimNominativ
(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.

PräpositionenmitAkkusativ und Dativ
(Prepositions with accusative and dative)
1. PräpositionenmitAkkusativ (prepositions with accusative)
2. PräpositionenmitDativ (prepositions with dative)
3. PräpositionenmitAkkusativoderDativ (prepositions with accusative or dative)

(With examples, writing and hearing exercises, and German to English Glossary as applicable)

UNIT - III

Konjugation von VerbenimPräsens
(Conjugation of verbs in present tense)
Verbs are conjugated by attaching certain endings, depending on the person and number of the subject.

Trennbare und untrennbareVerben
(separable and inseparable verbs)
Verbs with prefixes are dinstinguished 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. TrennbareVerben (separable verbs)
2. UntrennbareVerben (inseparable verbs)

Konjugation von VerbenimPerfekt
(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 Perfektsmit „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 ModalverbsimSatz
(Position of the modal verb within a sentence)

(With examples, writing and hearing exercises, and German to English Glossary as applicable)

13

Course Outcomes:	At the end of the course student will be able to
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.
2.	Differentiate between nomnative and akkusative cases with transitive and intransitive verbs, and negation with Kein/e/er
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.
4.	Differentiate preposition forms when used exclusively in akkusative or Dative forms or on combination of the two cases
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.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2
HU1502-1.1						3			2	1		1		
HU1502-1.2						3			2	1		1		
HU1502-1.3						3			2	1		1		
HU1502-1.4						3			2	1		1		
HU1502-1.5						3			2	1		1		

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Ulrich Haessermann, Georg Dietrich, Christianne C. Guenther, Diethelm Kaminski, Ulrike Woods and Hugo Zenker, Sprachkurs Deutsch Neusaffung 1, UnterrichtswerkfuerErwachsene, Verlag Moritz Diesterweg, Universitaetsdruckerei H. Stuertz AG Wuerzburg, 1989
2.	Paul Coggle and HeinerSchenke, Teach Yourself German (a complete course in understanding, speaking and writing), Teach Yourself Books, Hodden& Stoughton Educational, UK, 2101
3.	Langenscheidt German In 30 Days: Book + Cd Paperback, www.amazon.in, – 1 September 2111

REFERENCE MATERIALS:

1.	Deutsche SprachlehrefürAusländer.
2.	ThemenAktuell (Text and workbook).
3.	Deutsch alsFremdsprache 1A.
4.	Tangram Aktuell 1A/1B (Text and workbook).
5.	Wherever required the Videos/Audios are also played in the class room sessions

E-RESOURCES:

1.	https://onlinecourses.nptel.ac.in/noc21_hs30/preview NPTEL-Swayam, German-I by Prof. MilindBrahme ǀ IIT Madras
2.	https://www.traingerman.com/en/ powered by Sprachinstitut TREFFPUNKT Online

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SUSTAINABLE DEVELOPMENT GOALS			
Course code	21ME8X75	**CIE Marks**	50
Teaching Hours/Week (L:T:P)	3:0:0	**SEE Marks**	50
Total Hours	39	**Credits**	03

Course Learning Objectives:
Sustainable Development Goals is a 2116 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

13 Hours

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

13 Hours

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.

13 Hours

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:
1. Sachs, Jeffrey D. The age of sustainable development. Columbia University Press, 2115
2. Gagnon, B., Leduc, R., and Savard, L., Sustainable development in engineering: a review of principles and definition of a conceptual framework. Cahier de recherche / Working Paper 08-18, 2108.
3. Dalby, Simon, et al. Achieving the Sustainable Development Goals: Global Governance Challenges. Routledge, 2119.
4. Sustainability: A Comprehensive Foundation by Tom Thesis and JonathanTomkin, Editors.

REFERENCE BOOKS:
1. Elliott, Jennifer. An introduction to sustainable development. Routledge, 2112.
2. Day, G.S., and P.J.H. Schoemaker (2111), Innovating in uncertain markets: 10 lessons for green technologies, MIT Sloan Management Review, 52.4: 37-45.

MOOC Resources:
1. https://www.un.org/sustainabledevelopment/poverty/

Course Articulation Matrix

Course Code / Name : 21ME/ SUSTAINABLE DEVELOPMENT GOALS														
Course Outcomes (CO)	Program Outcomes (PO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1	1	3	3	1	1	1		2	1	1
2	2	2	1	1	1	3	3	2	1	1		1	1	1
3	3	2	2	1	1	3	3	2	3	1		1	1	2
4	3	2	3	1	1	3	3	2	1	1		1	3	2
5	1	2	2	1	1	3	3	2	2	2		1	1	1

1: Low   2: Medium   3: High

Scheme of SEE Question Paper

There will be **8** questions of **21** 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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WEB TECHNOLOGIES			
Course Code	21IS8X76	**CIE Marks**	50
Teaching Hours/Week (L:T:P)	3:0:0	**SEE Marks**	50
Total Hours	39	**Credits**	03

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

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:

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C8X52.1	Adapt HTML and CSS syntax and semantics to build web pages	L2
C8X52.2	Construct and visually format tables and forms using HTML and CSS	L3
C8X52.3	Experiment with the usage of Event handling and Form validation using Java script	L3
C8X52.4	Understand the principles of object oriented development using PHP and Database concepts	L2
C8X52.5	Inspect JavaScript frameworks like jQuery whichfacilitates developer to focus on core features.	L2

Course Outcomes (COs)	Program Outcomes (POs) Addressed	Performance Indicators (PI)	Bloom's Taxonomy Level (BTL)
**Table: Mapping of COs to PIs, POs and BTL**
CO1	1,3	1.3.1,1.4.1,3.2.1,	L2
CO2	1,2,3	1.4.1,3.2.1,3.2.2,2.1.1,2.2.4,3.1.6	L3
CO3	1,3	1.4.1,3.2.1,3.2.2,3.4.3	L3
CO4	1,2,3	1.4.1,3.2.1,3.2.2,2.1.1,2.2.4,3.1.6	L2
CO5	1,3	1.4.1,3.2.1,3.2.2	L2

Mapping Course Outcomes with Programme Outcomes:

POs COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C8X52.1	1	2		2								1	2	
C8X52.2	1			2								1	2	
C8X52.3	1	2		2	3							1	2	
C8X52.4	1	2		2	3							1	2	
C8X52.5	1			2	3							1	2	

(L/1=Low30%-49%,M/2=Medium50%-69%,H/3=High>70%)

TEXTBOOK:
1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", 1stEdition, Pearson Education India. (ISBN:978-9332575271)

E RESOURCES:
1. nptel.ac.in/courses/106105084/11

SEE Question Paper Pattern:
There will be **8** questions of **21** 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			
Course Code	**21CS8X77**	**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. 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.
Inheritance: inheritance basics, using super, creating multi-level hierarchy, method Overriding, abstract classes, final classes.

15 Hours

UNIT – II

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

15 Hours

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.

09 Hours

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

Table-2: Mapping Levels of COs to POs / PSOs															
COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	3			2				1	1		1	2	3	
CO2	1	2	2		1				1	1		1		3	
CO3	1	2	3		1				1	1		1		3	2
CO4	1	2	3		1				1	1		1	2	3	3
CO5	1	2	3		1				1	1		1		3	3

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:
   1. Herbert Scheldt, Java the Complete Reference, 7th Edition, Tata McGraw Hill, 2107. (Chapters 2-11, 22-24, 29,30)

REFERENCE BOOKS:

1. Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, Pearson Education, 2108, ISBN:9788131721806
2. Rajkumar Buyya,S Thamarasi selvi, xingchen chu, Object oriented Programming with Java, Tata McGraw Hill education private limited.
3. Richard A Johnson, Introduction to Java Programming and OOAD, CENGAGE Learning.
4. E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies.

E-Books / Online Resources:

1. Online course material by Oracle :
        http://docs.oracle.com/javase/tutorial/index.html
2. https://www.udemy.com/courses/search/?q=java&price=price-free&view=grid

MOOC:

1. Oracle: *www.oracle.com/events/global/en/java.../java-a-beginners-guide-1721064.pdf*
2. NPTEL:*www.nptelvideos.com/java/java_video_lectures_tutorials.php*

SEE SCHEME:
There will be **8** questions of **21** 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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DATA STRUCTURES AND ALGORITHMS			
Course Code	21CS8X78	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	3:0:0	**SEE Marks**	**50**
Total Hours	39	**Credits**	**03**

<u>**Course Learning Objectives**</u>:

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(), IsQueueFul(), IsQueueEmpty())

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:

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.

15 Hours

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.

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.

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2						1				1	3		
CO2	3	1	2					1				1	3		
CO3	3	2						1				1	3		
CO4	2	3												2	
CO5	2	2	3	2	3				1			1		3	

Table-2: Mapping Levels of COs to POs / PSOs

3: Substantial (High)   2: Moderate (Medium)   1: Poor (Low)

TEXTBOOKS:

1. Aaron M. Tenenbaum, Yedidyah Langsam & Moshe J. Augenstein, "Data Structures using C", Pearson Education/PHI, 2106.
2. Anany Levitin, "Introduction to the Design & Analysis of Algorithms", 2nd Edition, Pearson Education, 2107.

REFERENCE BOOKS:

1. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd edition, Universities Press, 2114.
2. Seymour Lipschutz, "Data Structures, Schaum's Outlines", Revised 1st edition, McGraw Hill, 2114.
3. Thomas H. Cormen, Charles E.Leiserson, Ronal L. Rivest, Clifford Stein, "Introduction to Algorithms", 2nd Edition, PHI, 2106.

MOOCs:

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/
3. Data Structure by Harvard Extension School, URL: http://www.extension.harvard.
4. http://nptel.ac.in/courses/106101060/

SEE SCHEME:

There will be **8** questions of **21** 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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ELECTRIC VEHICLE TECHNOLOGY			
Course Code	21EE8X79	**CIE Marks**	50
Teaching Hours/Week (L:T:P)	3:0:0	**SEE Marks**	50
Total Hours	39	**Credits**	03

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

Vehicle Mechanics: Roadway Fundamentals, Laws of Motion, Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion Power, Force-Velocity Characteristics, Maximum Gradability, Velocity and Acceleration, Constant FTR, Level Road, Velocity Profile, Distance Traversed, Tractive Power, Energy Required, Nonconstant FTR, General Acceleration, Propulsion System Design.
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, Super capacitors.

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.
3. Model batteries, Fuel cells, PEMFC and super capacitors.
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.

Course Outcomes Mapping with Program Outcomes & PSO												
Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
21EE8X .1	2	3										
21EE 8X .2	1	2	3									
21EE 8X .3	1	2	3									
21EE 8X .4	1	2	3									
21EE 8X .5	1	2	2									

1: Low 2: Medium 3: High

SEE QUESTION PAPER PATTERN:

- There will be **8** questions of **21** 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. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Husain, CRC Press, 2103
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, M. Ehsani, Y. Gao, S.Gay and Ali Emadi, CRC Press, 2105

REFERENCE BOOKS:

1. Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Sheldon S. Williamson, Springer, 2113.
2. Modern Electric Vehicle Technology, C.C. Chan and K.T. Chau, OXFORD University, 2101
3. Hybrid Electric Vehicles Principles And Applications With Practical Perspectives, Chris Mi, M. Abul Masrur, David Wenzhong Gao, Wiley Publication, 2101

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
6. Electric Cars: Technology | My MOOC (my-mooc.com)

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NATIONAL CADET CORPS: ORGANIZATION, FUNCTIONS AND CAPABILITIES

Course Code	21HU8X81	Course Type	OEC
Teaching Hours/Week (L:T:P:S)	3:0:0:0	Credits	03
Total Teaching Hours	39+0+0	CIE + SEE Marks	50+50

Teaching Department: Chemistry

Course Learning Objectives:

1.	To create evolved youth, who will be equipped to contribute in the development of the nation.
2.	To train students so as to achieve their physical and mental endurance. To acquire body language of a smart soldier and to inculcate the sense of authority by commanding the troop under him/her.
3.	To inculcate spirit of adventure, undertake adventure activities, to hone leadership qualities and risk-taking abilities.
4.	To understand and develop life skills, soft skills and to improve the emotional quotient of the student.
5.	To impart basic military training, to develop awareness about the defense forces and expose learners to military ethos / values

UNIT – I

NCC: Aims, Objectives and Organization NCC General, Aims, Objectives and Organization of NCC. Duties of NCC Cadets, NCC Camps: Types and Conduct. National Integration: Importance and Necessity, Unity in Diversity.	7
Personality Development Self-Awareness, Empathy, Critical and Creative Thinking, Decision Making and Problem Solving. Communication Skills, Coping with stress and emotions. Leadership: Traits, Indicators, motivation, moral values, Honor Code. Social Service and Community Development.	7

UNIT – II

Naval Communication and Seamanship Naval Communication: Introduction, Semaphore, Navigation: Navigation of Ships- Basic requirements, Chart work. Seamanship: Introduction to Anchor work, Rigging Capsule, Boat work- Parts of Boat, Boat pulling instructions, Whaler sailing instructions. Ship Modeling.	8
Disaster management and environmental awareness Disaster Management- Organization, Types of Disasters, Essential Services, Assistance, Civil Defence organization. Adventure Activities. Dos and Don'ts, Fire services and Firefighting, Environmental Awareness and Conservation.	8

UNIT – III

Naval Orientation Naval Orientation- Armed Forces and Navy Capsule, EEZ Maritime Security & ICG. Border & Coastal Areas: Security setup and Boarder/Coastal management in the area. Naval Orientation: Modes of Entry- IN, ICG, Merchant Navy. Border and Coastal areas: Security Challenges & role of cadets in Border management	9

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

1.	Display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion.
2.	Demonstrate the sense of discipline, improve bearing, smartness, turnout and develop the quality of immediate and implicit obedience of orders, with good reflexes.
3.	Acquaint, expose & provide knowledge about Army/Navy/ Air force and acquire information about expanse of Armed Forces, service subjects and important battles.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2
HU1505-1.1						3	3	1						
HU1505-1.2						3	3							
HU1505-1.3									1					

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Cadets Handbook, R.K. Guptha, Ramesh Publishing House, New Delhi.

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FUNDAMENTALS OF IMAGE PROCESSING – A PRACTICAL APPROACH			
Course Code	21EC8X82	CIE Marks	50
Teaching Hours/Week (L:T:P)	2:0:1	SEE Marks	50
Total Hours	26:0:26	Credits	03

Course Learning Objectives:

This course will enable the students to
1. Understand basic operations on images.
2. Understand the concepts of colour models.
3. Explain image enhancement techniques.
4. Perform morphological operations on images.
5. Perform thresholding operation for image segmentation.

Software Tool Required: MATLAB

Image Fundamentals: Description of Image and Basic operations: Image Brightening, Darkening, Addition, Subtraction, Multiplication and logic operations,Binary and Gray scale images, Color Fundamentals.

Image Enhancement Techniques: Concept & Importance of Histogram, Basic gray level transformations, Histogram processing, Basics of spatial filtering, smoothing spatial filters, sharpening filters.

Morphological Operations and Thresholding: Introduction, Erosion and Dilation, Opening and Closing, Thresholding, segmentation methods.

26 Hours

List of Experiments:
1. Introduction to MATLAB.
2. Reading and analyzing images.
3. Image Conversions.
4. Basic operations on images.
5. Basic Arithmetic operations on images- Addition, Subtraction and Multiplication.

6. Exploring Image manipulation operations.
7. Histogram processing.
8. Demonstration of Effects of Filters on images-Smoothing.
9. Demonstration of Effects of Filters on images-Sharpening.
10. Exploring different color models.
11. Demonstration of Morphological Operations.
12. Demonstration of thresholding operations.
13. Exploring image segmentation methods.

Scheme of SEE
Laboratory based evaluation

Course Outcomes:
At the end of the course the student will be able to
1. Demonstrate the understanding of basic operations on images
2. Apply image enhancement methods
3. Perform segmentation operation

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	3	-	-	1	1	1	1	-	-	-	-
CO2	3	-	-	-	3	-	-	1	1	1	1	-	-	-	-
CO3	3	-	-	-	3	-	-	1	1	1	1	-	-	-	-

3 – High   **2 – Medium**   **1 - Low**

TEXTBOOKS:
1. R. C. Gonzalez and R. E Woods, "**Digital Image Processing**", Pearson education (Asia)/Prentice Hall of India, 3rd Edition, 2109.
2. R. C. Gonzalez and R. E Woods, "**Digital Image Processing Using MATLAB**", Pearson education (Asia)/Prentice Hall of India, 2nd Edition, 2111.
3. 1.S. Jayaraman, S Esskairajan "**Digital Image Processing**", illustrated, Tata McGraw-Hill Education,2111.

NPTEL/ MOOC Link:

1. https://nptel.ac.in/courses/117105135/
2. https://nptel.ac.in/courses/117105079

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INTRODUCTION TO YAKSHAGANA			
Course Code	21HU8X86	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Hours	39	Credits	03

Course Learning objectives:

The course will enable the students to:
1. Gain basic understanding of Thenku Thittu Yakshagana.
2. Perform basic movements.
3. Understand speech/dialogue, rhythm, Entry and improvisation skills.

UNIT – I

Introduction: Meaning and features, Origin and development, Difference between Thenkuthittu
and Badaguthittu yakshagana. A brief introduction to Thenkuthittu Yakshagana.
Thalas-Aadi thala, yeka thala, Kore thala and Asta Thala with biditha and mukthya- Practice.
Dhingina – Practice……………………………………………………………….

14 Hours

UNIT – II

Thalas- Rupaka Thala, Trivide Thala, Jampe thala etc. with biditha and mukthaya.
Dhigina – Practice
Rangasthala Pravesha steps and Eripada ettugade steps.
Revision of all Thalas. …………………………………………………………………

14 Hours

UNIT – III

Yakshagana Prasanga Practice- Abhinaya and presentation………………………..

11 Hours

Performance: The final part of the course is the performance. A Prasanga will be chosen and taught
to the participants and they will perform the same in front of a live audience.

REFERENCE BOOKS:
1. Arthayana: Yakshagana Talamaddale Arthagarike: Ondu Vishleshane: Dr.Ramananda Banari.
2. Yaksha Naatyanjali Thenkuthittu- Sampadaka: Sathish Madivala, Karkala.
3. Yakshagna Shikshana Patya Pustka- Prathamika vibhaga (Karnatka Patya pusthaka sangha-
   Bengaluru)
4. Koralara: YakshaganaVimarsha Sankalana: Dr.M. Prabhakara Joshi
5. Vaagartha Gawrava: (Dr. Joshi Abhinandana Guchaha): Ga. Na. Bhat

MARKETING MANAGEMENT			
Course Code	21ME8X88	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. Understand and learn the marketing concepts and their application to profit-orientedand non-profit oriented organizations.
2. Able to apply the marketing concepts to analyze the buying behavior & marketing segments to solve these problems.
3. Understand and learn the need for a customer orientation in product pricing & marketing research in the competitive global business environment;
4. Able to develop an understanding and acquiring skills in how to successfully design and implement marketing plans and strategies.
5. Understand and learn the concept of sales, advertising &distribution of marketing mix and its application in traditional and novel environments characterized by emerging information technologies.

UNIT - I

BASICS

Definition, Marketing Process, Dynamics, Needs, Wants & Demands, Marketing Concepts, Environment, mix, types, philosophies, Selling Vs. Marketing, organization, Industrial Vs. Consumer Marketing, Consumer goods, Industrial goods, Product hierarchy.

8 Hours

BUYING BEHAVIOUR & MARKET SEGMENTATION

Cultural, Demographic factors, Motives, types, Buying decisions, segmentation factors, Demographic, Psychographic & Geographic Segmentation, Process, Patterns.

8 Hours

UNIT - II

PRODUCT PRICING & MARKETING RESEARCH

Objectives, pricing, Decisions and Pricing methods, Pricing Management. Introduction,Uses, process of Marketing Research.

8 Hours

MARKETING PLANNING & STRATEGY FORMULATION

Components of a marketing plan, strategy formulations and the marketing process, implementation, Portfolio analysis, BCG, GEC grids.

8 Hours

UNIT - III

ADVERTISING, SALES PROMOTION & DISTRIBUTION

Characteristics, Impact, goals, types, Sales promotion-Point of Purchase, Unique Selling proposition.

Characteristics, Wholesaling, Retailing, channel design, logistics, Modern Trends inretailing.

7 Hours

<u>**Course Outcomes (CO):**</u>

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

CO1	Explain the basic marketing concepts
CO 2	Interpret the buying behaviour of customers and role of marketing segments
CO3	Explain the role of product pricing and marketing research in the competitive global business environment
CO4	Analyse the marketing plans and strategies.
CO5	Explain the role of sales, advertising and distribution in marketing to achieve thegoals of marketing

TEXTBOOK:

1. Govindarajan. M. 'Modern Marketing Management', Narosa Publishing House,New Delhi, 1999

REFERENCE BOOKS:

1. Philip Kolter, " Marketing Management: Analysis, Planning, Implementation and Control ", 1998.
2. Green Paul.E. and Donald Tull, " Research for Marketing Decisions ", 1975.
3. Ramaswamy.V.S. and S.Namakumari, " Marketing Environment: Planning, Implementation and Control the Indian Context ", 1990
4. Jean Plerre Jannet Hubert D Hennessey Global Marketing Strategies.

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