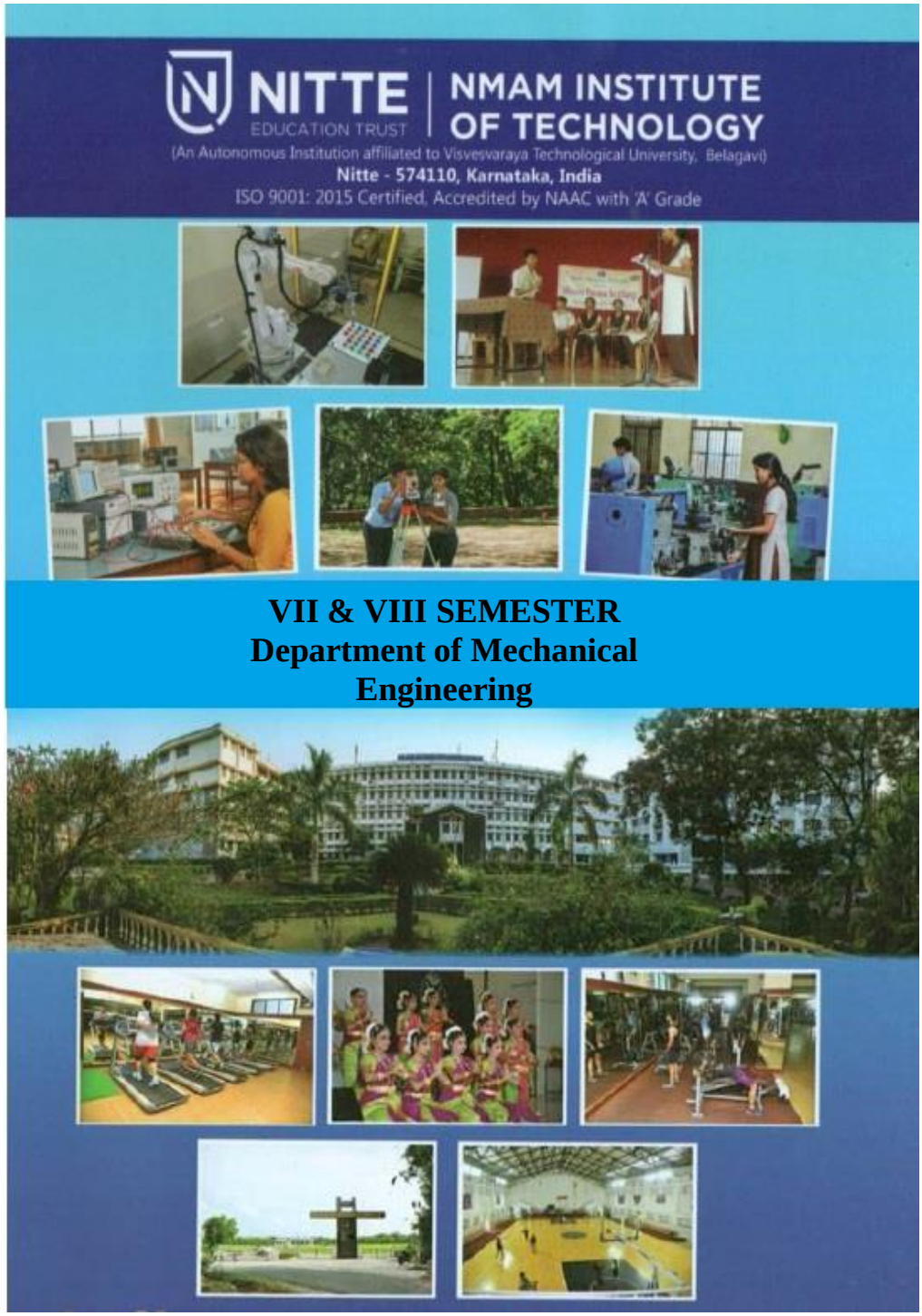
NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

College Calendar 2024-25

Department of Mechanical Engineering

Syllabus of 4th Year


NITTE
EDUCATION TRUST
NMAM INSTITUTE OF TECHNOLOGY
(An Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi)
Nitte - 574110, Karnataka, India
ISO 9001: 2015 Certified, Accredited by NAAC with 'A' Grade
VII & VIII SEMESTER
Department of Mechanical Engineering

College Calendar 2024-25

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, दिशाओं में कीर्ति फैलाती है। कल्पवल्ली की तरह वह सब कामनाये 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.

(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
2024-25
(VII & VIII Semester)

NITTE
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Vision Statement

Pursuing Excellence, Empowering people, Partnering in CommUNIT y 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. Radhakrishna	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.	Dr. Roshan Fernandes	HoD, Cyber Security
18.	Dr. Durga Prasad	Incharge, ACT
19.	Dr. Sushma	Incharge VLSI
20.	Mr. Bharath G Kumar	Head, Training & Placement Cell

INCHARGE OF INSTITUTION'S RESPONSIBILITIES

1.	Dr. Gururaj Upadhyaya	Workshop Suptd
2.	Dr. Joy Elvine Martis	1st year Coordinator
3.	Dr. Jnaneshwar Pai Maroor	Co-ordinator Alumni
4.	Dr. Venkatesh Kamath	Assistant CoE
5.	Dr. Janardhan Nayak	Co-ordinator – Red Cross UNIT
6.	Mr. Srinivas Nekkar	NCC Officer
7.	Mr. Krishnaraja Joisa	Public Relation Officer
8.	Mr. K. Sathish Nayak	Digital Media Executive
9.	Dr. Shashikanth Karinka	Student Welfare Officer
10.	Dr. Vijeesh	Assoc. Director (R&D)

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
2.	Dr. Ahishek Bhardwaj	T&P Associate

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
8.	Dr. Murari M S	Asst. Professor Gd III

DEPARTMENT OF CHEMISTRY

1.	Dr. Janardhana Nayak	Professor
2.	Dr. Ramesh Bhat	Asso. Professor
3.	Dr. Shivaprasad ShettyM.	Asso. Prof/HoD
4.	Dr. Santhosh Tiwari	Asso. Professor
5.	Dr. Aarti S. Bhat	Asst. Professor Gd III
6.	Dr. Subrahmanya Ishwar Bhat	Asst. Professor Gd III

7.	Dr. Sarvajith MS	Asst. Professor Gd III
8.	Dr. Ranjitha	Asst. Professor Gd III
9.	Dr. Shreya Kamath	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. Shwetha	Asst. Professor

11. **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. Manjunatha Suvarna	Hostel Manager, Gents Main Hostel
2.	Mr. Rajesh Ballal	Manager, Gents PG Hostel
3.	Mrs. Gayathri Kamath	Manager, Ladies PG Hostel
4.	Mrs. Chethana Sharma	Manager, Ladies Main Hostel
5.	Mrs. Hema S. Hegde	Superintendent, Hostel Office
6.	Mr. Kiran Kumar Annappa Kulal	Hostel Manager, Gents Main Hostel

REGULATIONS

2024-25

(Applicable for admission batch 2021-22 onwards)

NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

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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 7^{th} 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 6^{th} 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 6^{th} & 7^{th} 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 O, A+, A, B+, B, C, P, 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) Absolute Grading – Letter Grade and its range

The grade point scale for absolute grading

Marks Range (%)	**Grade Point**	**Letter Grade**	**Descriptor**
90 & above	10	O	Outstanding
80-89	9	A+	Excellent
70-79	8	A	Very Good
60-69	7	B+	Good
55-59	6	B	Above Average
50-54	5	C	Average
40-49	4	P	Pass
00-39	0	F	Fails
Absent	0	AB	Absent

CGPA	Classification
7.00 & above	**First Class with Distinction**
6.00-6.99	**First Class**
5.00-5.99	**Second Class**
CGPA <5.00*	**Academic Probation / Non-compliance**

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.

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

CGPA is computed as follows:

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

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 5thto 8thsemester 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 $5^{th}$to 8^{th}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 (≥ 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.

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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/-		
	Category I : Income Below Rs.2,50,000/-	*Online application*	

For Others	***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.**

Department of Mechanical Engineering

Syllabus of 4th Year

SCHEME OF TEACHING AND EXAMINATION

B.E.in Mechanical Engineering													
VII Semester													
SN	**Course Category**	**Course Code**	**Course Title**	**Teaching Department**	**Teaching Hours / Week**				**Examination**				**Credits**
					Lecture	**Tutorial**	**Practical/ Drawing**	**Self-Study Component**	**Duration**	**CIE Marks**	**SEE Marks**	**Total Marks**	
					L	**T**	**P**	**S**					
1	PCC	21ME701	Industrial Robotics	ME	3	0	0	0	3	50	50	100	3
2	PCC	21ME702	Power Plant Engineering	ME	3	0	0	0	3	50	50	100	3
3	PEC	21MEE1XX	Professional elective course – II	ME	3	0	0	0	3	50	50	100	3
4	PEC	21MEE2XX	Professional elective course – III	ME	3	0	0	0	3	50	50	100	3
5	OEC	21ME8XXX	Open elective Course – II	ME	3	0	0	0	3	50	50	100	3
6	PROJECT	21ME703	Project Work	ME	Two contact Hours / week for interaction between the faculty and students				3	100	100	200	9
TOTAL									**-**	**350**	**350**	**700**	**24**

PROJECT WORK (21ME703): The objective of the Project work is- To encourage independent learning and the innovative attitude of the students. To develop interactive, communication, organization, time management, and presentation skills. To impart flexibility and adaptability. To inspire independence and team working. To expand intellectual capacity, credibility, judgment, intuition. To adhere to punctuality, setting and meeting deadlines. To instill responsibilities to oneself and others. To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the evaluation of project work 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.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work 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.

ANNEXURE-I

Evaluation of the Theory and Practical Integrated Courses (TPICs):

1 The credit for TPICs shall be 04. This may be subdivided in any appropriate form depending on the type of course, however, ensuring at least 2 Hours for hands-on experience at the laboratory.

The 04 credits can be arranged to have the following teaching Hours.

(a) 3L:0T:1P, 4 credits, 05 Hours.

(b) 2L:1T:1P, 4 credits, 06 Hours.

In both the cases (i.e., a and b above), the syllabus of the theory part shall be designed for 40 Hours and the number of experiments/ programmes shall be sufficient enough to cover in 12 to 14 days of 16-week duration of the semester.

2 The maximum marks for TPICs shall be 100 marks.

3 Fifty marks of the maximum marks of TPICs shall be for CIE and the other 50 marks shall be for SEE of the theory part of TPICs.

4 The CIE marks for the theory part of the TPIC shall be 30 and for the laboratory part 20.

5 As continuous evaluation has been given more importance in NEP 2020, the minimum marks to be secured in CIE to appear for SEE shall be respectively 15 and 10. The laboratory part of the TPICs shall be for CIE only.

6 The theory part of the TPICs shall be for both CIE and SEE.

7 As continuous evaluation has been given more importance in NEP 2020, attendance shall separately be counted for theory and laboratory.

8 A minimum of 85 % attendance is to be put in for both theory and laboratory, with the condonation clause equally applying to both theory and laboratory.

9 In case, students fail to satisfy the attendance requirement of either the theory part or laboratory part of the TPIC, students shall not be permitted to appear for SEE of that semester and shall not be permitted to take admission to the next higher semester. The candidate shall be required to repeat that semester during the subsequent year.

10 In case, students satisfy the attendance requirement of both theory and laboratory part of the TPIC, but fail to secure the minimum CIE marks in any one of the two, such students shall not be permitted to appear for SEE of course. In such events, students shall be considered as fail in such a course and the same shall be considered for vertical progression.

Such students shall be permitted to register afresh and appear for SEE after satisfying the CIE requirements of the theory part (with or without satisfying the attendance requirement) or CIE requirements of the laboratory part, both when offered during the subsequent semester.

11 Each appearance to SEE to complete a course shall be treated as an attempt.

12 The theory paper examination shall be conducted for a maximum of 100 marks. The marks secured by students shall be reduced proportionately to 50 marks. The fractional value that results when secured marks are reduced to 50 shall be rounded off to a higher integer. For a pass in SEE, the minimum marks to be scored by students shall be 20 out of 50 or 40 out of 100.

13 The CIE marks awarded for tests in the theory of TPICs shall be based on three tests generally conducted at the end of a fifth, tenth, and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 20 marks.

14 Out of the remaining 10 marks, 05 marks shall be considered for the assignments /UNIT -tests/written quizzes and other 05 marks for open- book tests, for self-study or to test problem-solving skills.

15 On completion of every experiment/programme in the laboratory, the students shall be evaluated and marks shall be awarded on the same day.

16 While 15 marks are for conducting the experiment and preparation of the laboratory record, the other 05 marks shall be for the test conducted at the end of the semester.

The final CIE marks for the TPICs shall be the sum of the CIE marks earned for the theory and laboratory parts marks.

17 The eligibility to appear for SEE of TPICs shall be subject to the condition that students have earned minimum CIE marks separately in theory and practical parts of TPICs.

18 CIE marks of TPICs shall be submitted to the University in the format shown below.

Course code of TPIC		
CIE marks of theory part	CIE marks of laboratory part	Total
25	12	37

7th SEMESTER

Industrial Robotics

Course Code	21ME701	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Understand the Anatomy and applications of industrial robot.
2. Explain the robot kinematic and analyse its parameter.
3. Get an idea on trajectory planning and control of a robot joint.
4. Acquire the knowledge of robot vision systems components.
5. Demonstrate the types of robot layouts and method of programming.

UNIT -1

Introduction to Robotics

Definition, anatomy of robot, classification configurations, robot links and joints, robot specifications, resolution accuracy and repeatability, simple numerical problems, robot drive systems, hydraulic, pneumatic and electric drive systems, wrist and its motions, end effectors, types of end effectors, mechanical grippers, methods of constraining parts in grippers, types of gripper mechanisms, simple numerical problems, vacuum cups, magnetic grippers, adhesive grippers, hooks, scoops and other gripper devices, tool as end effectors, examples. Introduction to Drones.

Robot Motion Analysis

Direct kinematics and inverse kinematics, 3D homogeneous transformations, rotation, translation and displacement matrix, composite rotation matrix, rotation matrix about an arbitrary axis, links, joints and their parameters, Denavit-Hertenberg (D-H) representation, application of D-H matrices to different robot configurations.

15 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT -2

Robot Control

Basic control systems and models, transfer function with examples, transfer function for spring-mass-damper system, transient response of a second order system, transfer function of a robot joint, different types of controllers, proportional (P) controller, integral (I) controller, derivative (D) controller, PID controller, simple numerical problems.

Trajectory Planning

Trajectory planning, definition, steps in trajectory planning, joint space techniques, use of a p-degree polynomial as interpolation function, cubic polynomial trajectories, linear function with parabolic blends, joint space verses Cartesian space trajectory planning, simple numerical problems on joint space trajectory planning.

15 Hours

Pedagogy	Chalk and talk method, videos, Power Point Presentation

UNIT -3

Machine Vision

Machine vision, functions of machine vision system, sensing and digitizing, imaging devices, analog to digital signal conversion, quantization and encoding, simple numerical problems, image storage, image processing and analysis, image data reduction, segmentation, feature extraction, object recognition, robotic machine vision applications, inspection, identification, visual surveying and navigation.

Robot Programming

Introduction to robot programming, robot cell layout, work cell control and interlocks, manual programming, lead through and walkthrough programming, off-line programming, robot programming languages, examples, Programming with graphics, example. **9 Hours**

Pedagogy	Chalk and talk method, videos, Power Point Presentation

Course outcome (Course Skill Set)

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

CO 1 Describe the working concept and classification and types and drives of the robot.

CO 2 Identify, formulate and investigate direct kinematics and inverse kinematics problems for different robot configurations

CO 3 Apply engineering knowledge to review and solve trajectory planning and control schemes for robots.

CO 4 Understand machine vision systems in robotics.

CO 5 Analyze and formulate different types of robot cell layouts and use modern tools to write robot programs for different tasks.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS

1. Robotics and Control, R. K. Mittal, I. J. Nagrath, Tata-McGraw-Hill Publications, 2007.
2. Industrial Robotics,Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey, McGraw-Hill Publications, International Edition, 2008.

REFERENCE BOOKS

1. Robotics: Control, Sensing, Vision, Intelligence,Fu K. S., Gonzelez R. C., Lee C. S. G., McGraw Hill Book Co., International edition, 2008.
2. Robotics for Engineers, Yorem Koren, McGraw-Hill Publication, International edition, 1987
3. Introduction to Robotics: Mechanics and Control, Craig, J. J., Pearson Prentice-Hall Publications, 3PrdP edition, 2005.
4. Fundamentals of Robotics, Analysis and Control, Schilling R. J., Prentice-Hall Publications, Eastern Economy edition, 2007
5. Robotics, AppuKuttan K. K., I.K. International Publications, First Edition, 2007
6. Robot Technology Fundamentals, James G. Keramas, Cengage Learning, 1999

Web links and Video Lectures (e-Resources):

1. http://nptel.ac.in/courses/112101099/3

Course Articulation Matrix :

Course Code / Name : 21ME701 / INDUSTRIAL ROBOTICS															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	2	1	1	0	0	0	0	0	0	1	1	1	
CO 2	3	3	3	2	1	0	0	0	3	3	0	1	1	1	
CO 3	3	2	3	2	1	0	0	0	3	3	0	1	1	1	
CO 4	2	2	2	1	1	0	0	0	0	0	0	1	1	1	
CO 5	2	2	2	1	1	0	0	0	0	0	0	1	1	1	
1: Low 2: Medium 3: High															

Power Plant Engineering			
Course Code:	21ME702	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Understand the different types of fuels used for steam generation. Explain different types of equipment for burning coal in steam power plants. Know the methods of coal and ash handling in steam power plant.
2. Understand the working of high-pressure steam generators. Explain Working of Chimneys. Cooling towers and ponds used in steam power plant. Calculate the height of Chimneys required for the steam power plant.
3. Explain the working, applications and various components of Diesel Engine power plant. Understand the importance of hydrology. Explain the working and application of hydro-electric power plant.
4. Explain the working of the gas turbine plant and its parts. Explain the working and components of nuclear power plant. Know the waste disposal methods used in nuclear power plant.
5. Understand the importance of power station estimation and economics.

UNIT -1

Steam Power Plant

Different types of fuels used for steam generation, Equipment for burning coal in lump form, stokers, different types, Equipment for preparation and burning of pulverized coal, UNIT system and bin system. Pulverized fuel furnaces, cyclone furnace, Coal and ash handling.

Contd: Generation of steam

Using forced circulation, high and super critical pressures, A brief account of Benson, Velox, L'mont steam generators.

Chimneys: Natural, forced, induced and balanced draft, Calculations involving height of Chimney to produce a given draft.

Cooling towers and Ponds.

Accessories for the steam generators: Super heaters, De-super heater, Economizers, air pre heaters and re heaters.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Diesel Engine Power Plant:

Applications of Diesel Engines in Power field, Method of starting diesel engines, cooling and lubrication system for the diesel engine. Intake and exhaust system, general layout, advantages and disadvantages over steam power plant.

Hydro-Electric Plants

Storage and Pondage, flow duration and mass curves, hydrographs, low, medium and high head plants, pumped storage plants, Penstock, water hammer, surge tanks, power house general layout, advantages and disadvantages over thermal power plant.

Gas turbine Power Plant:

Advantages and disadvantages of gas turbine plant, open turbine plants with inter cooling, reheating and regeneration. Closed gas turbine power plant.

Nuclear Power Plant

Principles of release of nuclear energy, fusion and fission reactions, nuclear fuels used in the reactors, Elements of the nuclear reactor, moderator, control rod, fuel rods, coolants, Brief description of reactors of the following

types-Pressurized water reactor, boiling water reactor, sodium graphite reactor, fast breeder reactor and gas cooled reactor, radiation hazards, shielding, radioactive waste disposal. 15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Power station estimation:

Choice of site for power station, load duration curve, load factor, capacity factor, use factor, diversity factor, demand factor, effect of variable load on power plant, selection of the number and size of UNIT s.

Economics of power generation:

Cost of energy production, selection of plant and generating equipment and operating characteristics of power plants, tariffs for electrical energy. 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:

CO 1 Explain proximate and ultimate analysis of the coal. Illustrate the methods used for coal preparation, coal handling and burning (stoker and pulverised) of coal in steam power plants. Explain the methods used for ash handling in the power plant.

CO 2 Explain the method of steam generation in power plant using boilers. Differentiate the natural and forced draught and determine the height of the chimney to provide necessary draught. Describe the importance of cooling ponds, cooling towers and boiler accessories.

CO 3 Determine the availability of water of a river and storage capacity required using the concept of hydrology. Describe the components and working of hydroelectric power plant and diesel engine power plant.

CO 4 Describe the principle of nuclear energy release and differentiate nuclear fission and fusion reaction. Calculate energy released and fuel burn up during fission reactions. Explain the working of nuclear reactors and methods used for radioactive waste disposal. Explain open loop and closed loop gas turbine power plant and method used to improve the thermal efficiency.

CO 5 Discuss the social and environmental issues concerned with site selection. Explain the terminologies used in power plant economics. Calculate the energy produced using load and load duration curve. Calculate the cost of energy production and explain the tariff plans.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS

1. Power plant Engineering, P.K.Nag Tata McGraw Hill, 2 editions 2001
2. Power plant Engineering by Domakundawar,Dhanpath Rai Sons.2003
3. Power plant Engineering by R.K.Rajput. Laxmi Publication,New Delhi.
4. Principles of Energy conversion, AW.Culp Jr. McGraw Hill, 1996.
5. Non-conventional Energy sources by G.D.Rai Khanna Publishers

Web links and Video Lectures (e-Resources):

1. Power plant engineering by IIT Roorkee: https://youtu.be/tYBg-zsli98

Course Articulation Matrix :

Course Code / Name : 21ME702 / POWER PLANT ENGINEERING															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3					1	1			1		1		3	
CO 2	2	3				1	1			1		1		3	
CO 3	2	3				1	1			1		1		3	
CO 4	3	2				1	1			1		1		3	
CO 5	2	2				1	2			1		2		2	
1: Low 2: Medium 3: High															

Project work			
Course Code	21ME703	CIE Marks	100
Teaching Hours/Week(L:T:P:S)	Two contact Hours / week for interaction between the faculty and students	SEE Marks	100
Total Hours of Pedagogy	-	Total Marks	200
Credits	9	Exam Hours	3

Course Learning Objectives:

1. To expose engineering students to technology development at workplaces and appraise them regarding shop-floor problems.
2. To provide practical experience in solving open ended problems in real work setting so as to cause transfer of college based knowledge and skills to solve practical problems and thereby develop confidence in the students in the analysis, synthesis and evaluation of practical problems leading to creative thinking Programme.
3. During this work bench involvement, students will be given 3-4 practical problems. The problems assigned should be of mutual interest to the students and the industry. The problem may belong to 3 or 4 different functional areas.

To illustrate, following are some of the suggestions:

- Design of a prototype¨ Programming of CNC machines¨ Calibration and testing of instruments ¨ Productivity Improvement Studies¨ Pollution control related problems¨ Capacity Planning and Capital Budgeting¨ Safety Management¨ Optimum utilization of resources¨ Conflict Management methodology. The industrial organizations where students are to be sent for problem solving project-oriented work bench involvement may be selected well in advance¨ The faculty of the department is expected to visit the selected industries and identify suitable problems to be handled by students. It will be desirable that problems be matched with the interests of students.
- It is recommended that a group of 4 students be guided by one faculty member during this

period.

4. Preparing a project proposal including
    - Problem Identification
    - A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
    - List of possible solutions including alternatives and constraints
    - Cost benefit analysis
    - Timeline of activities
    - Identification of a real-life problem in thrust areas
    - Developing a mathematical model for solving the above problem
    - Finalization of system requirements and specification
    - Proposing different solutions for the problem based on literature survey
    - Future trends in providing alternate solutions
    - Detailed design and development plans
    - Preparation of part drawings for manufacturing.
    - Consolidated report preparation of the above or similar relevant academic activities suited for a particular project as approved by the guide.

Course outcome (Course Skill Set)

At the end of the course student will be able to

CO 1 Identify a real time application problem, relate it to the society and engineering based on literature survey, and propose a plan of action for solving the problem.

CO 2 Create a model/prototype through fabrication, simulation, data analysis, Experimentation

CO 3 Compose a technical paper/propose an idea and defend its novelty and suitability to the current need of the society/industry

CO 4 Prepare a technical report and demonstrate the project work through oral presentation

Assessment Details (both CIE and SEE)

SCHEME OF EVALUATION: Project demonstration, Viva voce

Total marks: 100 Marks

The distribution of marks shall be proportioned based on the type of the project and it is based on fulfilling the following requisites.

The evaluation of students is proposed to be done by internal faculty with active involvement of industrial personnel. The evaluation may be based on following criteria:

- Punctuality and Attendance ¨ Interpersonal relations
- Sense of Responsibility
- Clarity of concepts, principles and procedures
- Self-expression/communication skills
- Report Writing Skills
- Creativity/conceiving new and unusual ideas
- Problem-solving skills

At the end of the project work course students are required to submit a working model of the equipment they have designed and developed or if it is a theoretical or experimental work, they are expected to study a detailed analysis and findings from their work.

Continuous Internal Evaluation:

CIE procedure for Project Work :

(i)Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the evaluation of the project work 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.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the

project work, shall be based on the evaluation of project work 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.

Semester End Examination:

SCHEME OF EVALUATION:

SEE procedure:

i)**Single discipline:** Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department.

ii) **Interdisciplinary:** Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to.

Course Articulation Matrix :

Course Code / Name : 21ME703 / PROJECT WORK															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	3	2	2	1	3	1	3	1	3	3	1	3	3	3
CO 2	1	1	2	2	3	1	1	1	3	1	1	2	3	3	3
CO 3	1	1	2	3	1	3	3	3	3	3	3	3	3	3	3
CO 4	1	1	2	1	1	1	1	3	3	3	1	1	3	3	3
1: Low 2: Medium 3: High															

B.E.in Mechanical Engineering													
VIII Semester													
SN	**Course Category**	**Course Code**	**Course Title**	**Teaching Department**	**Teaching Hours / Week**				**Examination**				**Credits**
					Lecture	**Tutorial**	**Practical/ Drawing**	**Self-Study Component**	**Duration**	**CIE Marks**	**SEE Marks**	**Total Marks**	
					L	**T**	**P**	**S**					
1	SEMINAR	21ME801	Technical Seminar	ME	One contact hour / week for interaction between the faculty and students				--	100	--	100	01
2	INTERNSHIP	21INT81	Research Internship/ Industry Internship	ME	Two contact Hours / week for interaction between the faculty and students				3 (Batch wise)	100	100	200	15
								TOTAL	**-**	**200**	**100**	**300**	**16**

Note:(1) Institutions can swap 7th and 8th Semester Course work to accommodate industry/research internship at the end of the sixth semester (2)Credits earned for the course work shall be credited to the corresponding semester, i.e., 7th or 8thwhether 7th and 8th semesters were completed during the first half or second half of the IV year of program

Research / Industry Internship-(21INT81): shall be as far as possible be interdisciplinary in nature. If a provision is there all the students of the program can take up an internship in the 8th semester, if not 50% of students can take internship-III at the 7th-semester level, and the remaining 50% of students can take in 8th-semester level.

Note: PCC: Professional Core Course**, PEC:** Professional Elective Courses**, OEC –**Open Elective Course**, AEC –**Ability Enhancement Courses. **INT –**Internship

L–Lecture**,T–**Tutorial**,P-**Practical/Drawing**,S–**SelfStudyComponent**,CIE:**ContinuousInternalEvaluation**,SEE:**SemesterEndExamination

AICTE activity Points: In case students fail to earn the prescribed activity Points, the Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

Activity points of the students who have earned the prescribed AICTE activity Points shall be sent to the University along with the CIE marks of 8th semester. In case of students who have not satisfied the AICTE activity Points at the end of the eighth semester, the column under activity Points shall be marked NSAP (Not Satisfied Activity Points).

TECHNICAL SEMINAR(21ME801): The objective of the seminar is to inculcate self-learning, face the audience confidently, enhance communication skill, involve in group discussion, and present and exchange ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the program of Specialization.

- Carryout literature survey, systematically organize the seminar content.
- Prepare the report with own sentences, avoiding a cut and paste act.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through PowerPoint slides.
- Answer the queries and involve in debate/discussion.
- Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course: Seminar Report:50 marks Presentation skill:25 marks
Question and Answer:25 marks.

8th SEMESTER

Technical Seminar

Course Code	21ME801	CIE Marks	100
Teaching Hours/Week (L:T:P: S)	One contact hour / week for interaction between the faculty and students	SEE Marks	-
Total Hours of Pedagogy	-	Total Marks	100
Credits	1	Exam Hours	-

Course Learning Objectives:

1. Prepare seminar presentations using visual aids and seminar report.
2. Make oral presentation with proper communication and body language
3. Answer all technical queries regarding the seminar topic presented

Course outcome (Course Skill Set)

At the end of the course student will be able to

CO 1 Make effective presentations, with proper communication and body language.

Course Articulation Matrix :

Course Code / Name : 21ME801 / TECHNICAL SEMINAR															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1		2			3				3	3		3	1	1	1

1: Low 2: Medium 3: High

LIST OF PROFESSIONAL ELECTIVE COURSES

GROUP-I		GROUP-II	
SUBJECT CODE	**SUBJECT NAME**	**SUBJECT CODE**	**SUBJECT NAME**
21MEE101	Finite Element Methods	21MEE201	Advanced strength of materials
21MEE102	Control Engineering	21MEE202	Material selection for Engineering Design
21MEE103	Introduction to Aircraft Design	21MEE203	Design of Experiments
21MEE104	Fluid Power Systems	21MEE205	Mechanical Vibrations
21MEE105	Wind & Solar Power Engineering	21MEE206	Design of Aircraft Structures
21MEE106	Renewable Sources of Energy	21MEE209	Computational Fluid Dynamics
21MEE108	CAD / CAM	21MEE210	Internal Combustion Engines
21MEE109	Welding Technology	21MEE211	Gas Propulsion and Aerodynamics
21MEE110	Computer Integrated Manufacturing	21MEE212	Non Traditional Machining
21MEE111	Additive Manufacturing	21MEE213	Automation in Manufacturing
21MEE112	Total Quality Management	21MEE214	Foundry Technology
21MEE113	Maintenance & Reliability Engineering	21MEE215	Composite Materials Technology
21MEE114	Introduction to Machine Learning	21MEE216	Non Destructive Testing
21MEE115	Operations Research	21MEE217	Supply Chain and Logistic Management
21MEE117	Introduction to Piping Engineering	21MEE218	Organizational Behavior
21MEE118	Industrial Tribology	21MEE219	Management Information System
21MEE119	Energy Management	21MEE221	Introduction to Financial Management
21MEE121	Operations Management	21MEE222	Innovation and Entrepreneurship
21MEE122	Human Resource Management	21MEE223	Microelectromechanical Systems (MEMS)
21MEE123	Marketing Management	21MEE226	Cloud Computing

LIST OF OPEN ELECTIVE COURSES

OPEN ELECTIVE COURSES	
21ME8X33	Human Resource Management
21ME8X28	Operations Management and Entrepreneurship
21ME8X08	Industrial Pollution Control
21ME8X65	Automotive Engineering
21HU8X68	Introduction to Yoga
21ME8X75	Sustainable Development Goals
21ME8X88	Marketing Management

PROFESSIONAL ELECTIVE COURSES

GROUP-I

Finite Element Methods

Course Code	21MEE101	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Define FEM, classify various elements used in FEM and study node numbering and stress strain relationships.
2. Determine the deflection and stress at various points on cantilever, simply supported and fixed beams using Rayleigh-Ritz and Galerkin's method.
3. Understand various displacement polynomials using Pascal's triangle and obtain shape functions for different elements.
4. Implement the steps required for FEM to obtain appropriate solution to a variety of physical systems (Bar and truss) and obtain engineering design parameters.
5. Make use of direct method of analysis for analyze deflection and slope in beams and stress strain relationships in plates.

UNIT -1

Introduction: Definition of FEM, General Description of FEM, Engineering applications of FEM, Discretization process, Types of Elements – 1D, 2D, 3D and Axisymmetric elements, location of nodes, node numbering scheme, boundary conditions, half band width, stiffness matrix of bar elements by direct method, properties of stiffness matrix, preprocessing, post processing. Displacement of 3D Elastic body, Differential equations of equilibrium of stresses at a point, strain displacement relations, stress – strain relations for plane stress and plane strain.

Principle of minimum potential energy, Rayleigh – Ritz method, Galerkins Method, Numerical Integration.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Displacement models, Pascal Triangle - displacement functions for higher order quadrilateral & triangular elements, Shape functions, Derivation of Shape function for 1D linear element, quadratic element, CST element, Convergence & its types.

Finite element formulation of 1D linear element, Numerical problems on bars, stepped bars - solution of displacements, reactions and stresses by using elimination approach, penalty approach. Stress and strain in plane truss by direct stiffness method, Numerical problems.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -3	
Beams, Hermite Cubic polynomial function, Finite element formulation of beam element, Numerical problems on beams. Stress-strain analysis of 2D structural problems, Modeling of the plate continuum using triangular elements, Isoparametric formulation of CST elements. Derivation of Stress – Displacement Matrix, Derivation of Element matrices, Numerical problems. 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 :

CO 1 Understand the terminologies and basic concepts of FEM and its applications.

CO 2 Apply the knowledge of mathematics, science and engineering fundamentals to solve various engineering problems.

CO 3 Design solutions for complex engineering problems theoretically and understand the need for using different methods for solving these problems.

CO 4 Apply knowledge of mathematics and engineering fundamentals to solve problems related to bars and trusses.

CO 5 Apply knowledge of mathematics and engineering fundamentals to solve problems related to beam elements.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Finite Element Methods, Daryl L. Logon, Thomson Learning 6th edition, 2015.
2. Introduction to Finite Elements in Engineering, Chandrupatla T. R., 4th Pearson edition, 2014.

REFERENCE BOOKS:

1. The finite element method in Engineering, S S Rao, 5th edition, 2013
2. Introduction to the Finite Element Method, C. S. Desai and J.F. Abel
3. Finite Element Analysis – Theory & Programming, Krishnamoorthy C.S
4. Numerical Methods in Finite Element Analysis, Bathe K. J & E. L Wilson
5. Higher Engineering Mathematics, B. S. Grewal
6. An Introduction to the Finite Element Method J. N. Reddy

Course Articulation Matrix :

Course Code / Name : 21MEE101 / FINITE ELEMENT METHODS

Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	3	2					3	3	2	2	2
CO 2	3	2	3	2	3	2					1	2	2	2	2
CO 3	3	2	3	2	3	3					1	3	3	3	2
CO 4	3	3	3	3	3	3					3	3	3	3	2
CO 5	3	2	3	3	3	3					3	3	3	3	2

1: Low 2: Medium 3: High

Control Engineering			
Course Code	21MEE102	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	3	Exam Hours	3

Course Learning Objectives:

1. Understand the basic concept of control Engineering and to obtain mathematical model and transfer function of control system.
2. Obtain overall transfer by reduction algebra and signal flow graph.
3. Obtain the response equation of control system.
4. Understand the concept of stability and obtain the stability of system using Nyquist and Bode methods.
5. Obtain the system gain for stability by root locus plot and to understand the basic concept of control action.

UNIT - 1

Introduction: Control system , open and closed loop control systems, concept of feed back.

Mathematical Model: Transfer functions models, Models of mechanical systems, electrical systems, hydraulic systems and thermal systems.

Block diagram and signal flow graph: Block representation of system elements, example of the use of block diagrams, Block diagram Reduction, Signal flow graph, Mason's gain formula.

15 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT -2

System Responses: Types of input signals, First order and second order system response to step input, time response specification of second order system, numerical problems. System stability criteria, Routh stability criteria.
Generation of standard test signals, Step response for the given transfer function, Time domain specification for the given transfer function using MATLAB

Frequency Response: Polar and rectangular plots for the frequency response, Nyquist stability criterion, stability analysis. Phase and gain margin.
Stability analysis of linear systems using Nyquist plot in MATLAB.

System Analysis using logarithmic plots: Bode diagrams: Stability analysis using Bode diagrams. Stability analysis of linear systems using bode plot in MATLAB. **15 Hours**

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT -3

System Analysis using Root locus Plots: General rules for construction of Root Locus plots, analysis using root locus plot.

Stability analysis of linear systems using root locus plot in MATLAB.

Control action: Basic concept of Proportional control, integral control, derivative control, proportional plus derivation control, PID control.

Step response of P, PI, PID for a given transfer function using MATLAB.

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 :

CO 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.

CO 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.

CO 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.

CO 4 Analyse the stability of the control system using Nyquist criterion and Bode plot.

CO 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)

(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
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

Books

TEXTBOOKS:

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

REFERENCE BOOKS:

1. Harrison H.L. and Bollinger J.G. (1968) "Automatic controls", 2nd edition, International Text Book Co. U.S.A.
2. Gopal M (2005) " Modern Control Systems", New Age International Publisher
3. Benjamin.Kuo.C. (1995) "Automatic Control Systems", EEE, 7th Edition Prentice Hall of India Ltd. New Delhi
4. Appukuttan K. K. Control Engineering , Oxford university publication, 2009

Web links and Video Lectures (e-Resources):

Course Articulation Matrix :

Course Code / Name : 21MEE102 / CONTROL ENGINEERING

Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	3	2						1	1		1	3		1
CO 2	1	3	2						1	1		1	3		1
CO 3	1	3	2						1	1		1	3		1
CO 4	1	3	2						1	1		1	3		1
CO 5	1	3	2						1	1		1	3		1

1: Low 2: Medium 3: High

Introduction to Aircraft Design			
Course Code:	21MEE103	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Get an exposure to the Aerospace Industry. And understand the Basics of Aircraft and Aircraft Structures.
2. Understand basic principles of flight.
3. Appreciate the basic mechanics of flight.
4. Classify and appreciate the different aircraft design configurations, and aircraft systems
5. Appreciate the importance of different aircraft systems and subsystems

UNIT -1

Aircraft industry overview: Evolution and History of Flight, Types Of Aerospace Industry, Key Players in Aerospace Industry, Aerospace Manufacturing, , Prime contractors, Tier 1 Suppliers, Aerospace industry trends, Global and Indian Aircraft Scenario. Aircrafts Classification and Structure

Basic components of an Aircraft: Structural members, Aircraft Axis System, Aircraft Motions, Forces on the airplane, Control surfaces, Types of Aircrafts - Lighter than Air/Heavier than Air Aircrafts Basic Principles of Flight Aerofoil Nomenclature, Types of Aerofoil, Wing Section- Aerodynamic Center, Aspect Ratio, High lift devices(flaps and slats), Effect of flaps and slats on lift, drag and angle of attack. Significance of speed of Sound, Mach Numbers, Mach Waves, Mach Angles, Shock Waves, Sonic and Supersonic Flight and its effects.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Basics of Flight Mechanics Stability and Control: Meaning of stability, Definitions of static and dynamic stability, Types of static stability- Lateral, Longitudinal and Directional Stability, Maneuverability , Control Tabs, Landing, Gliding, Turning- Forces acting on a Aeroplane during a Turn, Loads during a Turn, Correct and incorrect Angles of Bank

14 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Aircraft Systems: Types of Aircraft Systems, Classification, Engine Control Systems, Types of engines- Turbo jet, Turbo fan and Turbo prop, Fuel systems, Hydraulic systems – open and closed loop hydraulic system. Landing gear systems, Ice and rain p r o t e c t i o n s y s t e m s and Air- Conditioning Systems, Brief overview electronics.

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:

CO 1 Summarize the importance of Aerospace and Airline Industry in design and Manufacturing sectors. Identify hardware components in Aircrafts Structures .

CO 2 Describe the basic principles of flight and Analyze the set-up and operations involved. Solve simple problems using principles of flight dynamics.

CO 3 Describe the basic mechanics of flight and flight dynamics.

CO 4 Classify the aircraft design configurations and aircraft systems

CO 5 Illustrate the various systems in macro-micro scaled architecture involved in Avionics and Explain the mechanical, electrical, hydraulic and thermal systems by applying knowledge of mathematics and physics.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Flight without Formulae by A.C Kermode, Pearson Education,10th Edition.
2. Mechanics of Flight by A.C Kermode, Pearson Education, 5thEdition.

Web links and Video Lectures (e-Resources):

Course Articulation Matrix :

Course Code / Name : 21MEE103/ INTRODUCTION TO AIRCRAFT DESIGN															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1			1		3	3	2	1	2		3			1
CO 2	1	2	1	1	3	2	3	1	1	1		2		2	1
CO 3	1	2	2	1	1	2	3	1	1	1		1	2	2	1
CO 4	1	1	1	1	1	2	3	1	1	1		2	1	1	1
CO 5	1			1		2	3	1	1	1		3			1
1: Low 2: Medium 3: High															

Fluid Power Systems			
Course Code	21MEE104	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. To understand the basic concept of Fluid power system and to apply Pascal's law.
2. To understand the construction and working principle of hydraulic pumps and motors.
3. To understand the construction and working principle of control valves.
4. To design and draw the hydraulic circuits for various applications of hydraulic system.
5. To understand the working principle of various parts of pneumatic system and to draw sim pneumatic circuits.

UNIT -1

Hydraulic system: - Basic structure of hydraulic control system. Hydraulic fluids: function, properties and types of fluids. Filters, sealing devices, accumulators.

Hydraulic Pumps: Classification, principle of working & constructional details of vane pump, gear pumps, radial & axial piston pumps, pump selection parameters, Power and efficiency calculations (pump performance).

Hydraulic Actuators: Rotary actuators (Hydraulic motors): Type and constructional features of vane, gear, axial piston, & radial piston. Numerical problems on performance of motor. Linear actuators (hydraulic cylinder): Types of cylinder and constructional features of single acting, double acting, tandem, telescopic and end cushioning cylinder, mechanics of cylinder loading, calculations of piston velocity, power, efficiency. Intensifier and its application.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Hydraulic control valves : Necessity of pressure control, directional control, flow control valves, **DIRECTION CONTROL VALVES :** Classification and constructional features. **PRESSURE CONTROL VALVE: :** Classification and constructional features. **FLOW CONTROL VALVES: :** Classification and constructional features

DESIGN OF HYDRAULIC CIRCUITS: Introduction to hydraulic circuit. Design and simulation of single acting and double acting cylinder actuation, Circuit illustrating use of different types of direction control valve, pressure control valve and flow control valve. Double pump circuit, Regenerative circuit, synchronization circuit, safety circuit, Intensifier circuit, accumulator circuits.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -3

Pneumatic System: Introduction to Fluid power, its advantages and applications, Pascal's Law and numerical problems on Pascal's Law. Introduction to pneumatic system, Comparison of Pneumatics with Hydraulic power transmission, Properties of air, gas laws. Basic structure of pneumatic system, classification and working of air compressor. Air dryer, Filter, Regulators & Lubricators. Linear and rotary actuators. Pressure regulating valves, Directional control valves, Flow control valves, logic valves, quick exhaust valve, time delay valve. Design and simulation of simple Pneumatic circuits

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 :

CO 1 Illustrate Pascal's law with real life examples of Fluid Power systems and calculate required parameters. Explain the construction and working of hydraulic pumps. Calculate the parameters and performance of hydraulic pumps for given conditions.

CO 2 Explain the construction and working of hydraulic actuators. Calculate the parameters and performance of hydraulic actuators for given conditions.

CO 3 Explain the construction and working of control valves using hydraulic symbols.

CO 4 Develop the hydraulic circuits for given applications using hydraulic symbols.

CO 5 Explain the construction and working of pneumatic system elements using hydraulic symbols. Develop the pneumatic circuits for given applications using pneumatic symbols.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

Books

TEXTBOOKS:

1. Fluid Power with application's - Anthony Esposito, Fifth edition, Pearson Education, Inc 2007.
2. Hydraulic and Pneumatic controls by R Srinivasan, Tata McGHraw Hill Publishing, 2011,S edition.
3. Oil Hydraulic systems – Principles and Maintenance - S.R. Majumdar, Tata McGraw Hill Pub Company Ltd. 2001.
4. Pneumatic systems - S. R Majumdar, Tata McGHraw Hill Publishing Co. – 2005.

REFERENCE BOOKS:

1. Pneumatics Basic Level TP 101- by Peter Croser & Frank Ebel, Festo Didactic publication - 1999.
2. Fundamentals of Pneumatic Control Engineering - J P Hasebrink & R Kobbler, Festo Didactic publication, 3PrdP edition – 1989.
3. Pneumatic Control for Industrial Automation - Peter Rohner & Gordon Smith, John Wiley Sons publication – 1989.
4. Power Hydraulics - Michael J Pinches & John G Ashby, Prentice Hall – 1989

Web links and Video Lectures (e-Resources):

Course Articulation Matrix :

Course Code / Name : 21MEE104 / FLUID POWER SYSTEMS

Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	1						1	1		1	3		
CO 2	2	3	1						1	1		1	3		
CO 3	3	2	1						1	1		1	2		
CO 4	1	2	3						1	1		1	3		
CO 5	1	2	3						1	1		1	3		

1: Low 2: Medium 3: High

Wind & Solar Power Engineering			
Course Code	21MEE105	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	3	Exam Hours	3

Course Learning Objectives:

1. Measure, estimate and predict the solar radiation at the given location.
2. Demonstrate different application of solar energy such as cooking, drying, cooling, power generation.
3. Design and suggest the photo voltaic cell for an application.
4. Estimate the parameters of wind energy and suggest it for applications.
5. Design the blade, suggest orientation system and regulating devices in wind turbine

UNIT -1

Solar Radiation - Empirical Equations - Solar Chart - Measurements of Solar Radiation and Sunshine – Solar Radiation Data
Solar Thermal Collectors - Flat Plate and Concentrating Collectors - Solar Heating and Cooling Techniques - Solar Desalination - Solar Pond - Industrial Process Heat – Solar Thermal Power Plant - Solar Thermal Energy Storage

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Introduction - Fundamentals of photo Voltaic Conversion - Solar Cells - PV Systems – PV ,Applications Wind Data and Energy Estimation - Wind Energy Conversion Systems - Wind Energy Collectors and its Performance - Wind Energy Storage - Applications of Wind Energy - Safety and Environmental Aspects

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Design of blade: Aerodynamic configuration of rotor and determination of blade structure. Orientation system and regulating devices. Description of vertical axis wind mills. Use of wind mill for water pumping.

9 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

Course outcome (Course Skill Set)

At the end of the course student will be able to

CO 1 Estimate solar radiation at the given location and explain solar radiation measurement devices
CO 2 Describe the use of solar thermal energy for domestic and industrial applications
CO 3 Describe the fundamentals of photovoltaic energy conversion and its applications. Explain steps involved in fabrication of photovoltaic cells

CO 4 Describe the working of wind data measurement devices. Explain construction and functioning of horizontal axis wind turbine

CO 5 Design wind turbine blades. Describe regulating and orientation devices for wind turbines

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS

. 1. WS.P. Suknofme, " Solar Energy Principle of Thermal Collection and Storage ", (1997), Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

2. G.D.Rai, " Non Conventional Energy Sources ", (1999), Khanna Publishers, New Delhi.

REFERENCE BOOKS:

.. 1. H.P.Garg and J.Prakash, " Solar Energy, Fundamentals and Applications " (1997), Tata McGraw Hill Publishing Company Ltd., New Delhi.

2. B.S.Magal, " Solar Power Engineering " (1993), Tata McGraw Hill Publishing Company Ltd., New Delhi.

3. J.R.Howell, R.B.Bannerot and G.C.Vtiet, " Solar Thermal Systems ", (1982), Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

4. J.A.Duffie and W.A.Beckman, " Solar Engineering of Thermal Process " (1991), John Wiley,New York.

5. Golding E.W. " The Generation of Electricity by Wind Power ", (1976), E and F N Spon Ltd., London.

6. Le Gourieres D., " Wind Power Plant, Theory and Design ", (1982), Pergamon Press, France.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=RqppRC37OgI
2. https://youtu.be/BTyJrRy8DUE

Course Articulation Matrix :

Course Code / Name : 21MEE105 / WIND & SOLAR POWER ENGINEERING															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	2	3	0	0	1	1	1	1	1	0	0	0	2	0
CO 2	3	1	1	0	0	1	1	1	1	1	0	0	0	2	0
CO 3	3	2	1	0	0	1	1	1	1	1	0	2	0	3	0
CO 4	3	2	0	0	0	1	1	1	1	1	0	0	1	2	0
CO 5	1	2	3	0	0	1	1	1	1	1	0	0	1	3	0
1: Low 2: Medium 3: High															

RENEWABLE SOURCES OF ENERGY			
Course Code:	21MEE106	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Identify different sources of Renewable energies and their possible use for the welfare of the Mankind.
2. Study the Conversion technologies, pros and cons, and application of solar energy
3. Study the Conversion technologies, pros and cons, and application of biomass energy & wind energy
4. Study the Conversion technologies, pros and cons, and application of ocean energy, tidal energy & wave energy
5. Study the Conversion technologies, pros and cons, and application of geothermal energy and types of fuel cells

UNIT -1

Energy sources- Introduction, Classification of Energy Resources; Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources;

Solar energy: Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (numerical problems), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical problems); Measurement of Solar Radiation Data – Pyranometer and Pyrheliometer.

Principle of Conversion of Solar Radiation into Heat, Flat Plate Collectors (Liquid flat plate collector), Effect of various parameters on the performance, testing procedure, Concentrating collectors – Introduction, cylindrical, parabolic collector, Compound parabolic collector, Central receiver collector.

Solar thermal applications - Solar pond, Solar Air heater, Solar Water heater, solar power generation, solar space cooling and refrigerator, solar distillation, solar drying, solar cooking, solar pumping, solar furnace. Solar photo Volatics.

Solar thermal energy storage – Introduction, Sensible, Latent and thermo Chemical storage, numerical problems **16 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Biomass Energy- Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Biomass Gasification, Biomass to Ethanol Production, Biogas production, factors affecting biogas generation, types of biogas plants

Wind Energy: Introduction, Power of wind energy, conversion systems, and types of wind machines, performance of wind machines with numerical problems, applications and prospects in India.

Tidal Power- Introduction, causes for tide formation, power of tide, numerical problems tidal power plants, advantages and limitations.

Ocean Thermal Energy – Introduction to O.T.E.C., open and closed cycle OTEC systems, prospects in India.

Wave Energy– Introduction, power of wave energy, numerical problems, and conversion devices. **16 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT - 3	
Geothermal Energy- Introduction, types of geothermal resources, methods of harnessing, geothermal energy applications, environmental problems and prospects in India. **Fuel Cells -** Introduction, Principle and operation of fuel cells, classification and types of fuel. Fuel for fuel cells, performance characteristics of fuel cells, application of fuel cells Energy **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:

CO 1 Explain solar physics and calculate solar energy radiation. Explain the solar energy collectors and methodologies of storing solar energy.

CO 2 Explain the applications of solar energy and methods of solar energy storage. Determine the amount of energy storage and volume of storage required.

CO 3 Explain the methods of wind energy and biomass energy conversion techniques. Determine power available in the wind and maximum amount of energy extracted from the wind. Determine the size of the biomass digester.

CO 4 Explain OTEC, tides and waves methods of harvesting energy from the ocean. Determine the energy from tides and waves.

CO 5 Explain the methods of utilising energy from geothermal resources.and types of fuel cells.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

REFERENCE BOOKS

1. Solar Energy by Dr. S.P.Sukhatme Tata McGraw Hill. 2008
2. Solar Energy utilization by G.D. Rai Khanna Publishers. 2004
3. Non Conventional Energy Sources by G.D.Rai.- Khanna Publishers. 2011
4. Power Plant Engineering by Arora, Domkundwar. Dhanpat Rai & Sons. 1999
5. Energy Technology (Non Conventional& Conventional) by S. Rao, Dr. B.B.Parulekar Khanna Publishers, third edition 2013

Web links and Video Lectures (e-Resources):

Course Articulation Matrix :

Course Code / Name : 21MEE106 / RENEWABLE SOURCES OF ENERGY															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3				1	2		1	1		1		2	
CO 2	2	3				1	2		1	1		1		2	
CO 3	2	3				1	2		1	1		1		3	
CO 4	2	3				1	2		1	1		1		2	
CO 5	3	1				1	2		1	1		1		2	
1: Low 2: Medium 3: High															

CAD / CAM			
Course Code	21MEE108	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	3	Exam Hours	3

Course Learning Objectives:

1. Able to understand the application of computers in design and manufacturing.
2. Understand the concepts for generation of lines and curves
3. Able to understand the surfaces and solid modelling concepts and develop simple models
4. Understand the concepts of NC , CNC machines and their roles in industries
5. Able to understand role of computers and recent developments in the manufacturing sector.

UNIT -1

Introduction to CAD and CAM

Product Cycle, Definition of CAD and CAM, use of computers in product cycle, Conventional design process, computer aided design, benefits of CAD. Advantages and disadvantages of CAD, ethics in CAD/CAM. Introduction to virtual reality, Ethics in CAD/CAM.

Hardware for CAD: Graphic displays – Image generation techniques, Direct beam refresh, Direct view storage, Raster scan, LED, LCD monitors, Display controller & display memory.

Introduction to exchange of modelling data – Basic features of IGES, STEP, DXF, and DMIS.

Graphics software: Transformations 2-D – Translation, Rotation and Scaling, Reflection

Geometric modelling: Algorithm for generation and display of simple graphical elements like lines, circle, ellipse.

Types and representation of curves: Synthetic curves – Cubic, Bezier & B-spline curves.

18 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT -2

Geometric surfaces and solid modelling: Types and representation of surfaces: Analytic surfaces – Plane, ruled, revolution and tabulated surfaces. Synthetic surfaces – cubic, Bezier and B-spline surfaces Types and representation of solids – Solid representation, half spaces, Boundary Representation (B-Rep), Constructive Solid Geometry (CSG).

NC, CNC and Adaptive control system

Basic components of NC, NC procedure, Classifications of NC, Machining centres, advantages and

disadvantages of NC, Problems with Conventional NC, Introduction to CNC, Functions of CNC, CNC part programming on turning and milling operations. Open CNC.

Adaptive control optimization, Adaptive control constraint, ACC for turning, Adaptive control of grinding, optimization strategy.

15 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT -3

Group Technology & Flexible Manufacturing: Part families, Part Classification & coding, Machine cell design & benefit of GT, FMS workstations, planning the FMS, FMS layout configuration. Analysis method, application and benefit of FMS. Shop floor control, Functions, Shop floor control system.

6 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 :

CO 1 Summarize the importance of computers in design and Manufacturing. Describe hardware components such as graphic display terminals, LED, LCD and display controller in Computers. Apply graphic transformation techniques to solve 2-D elements problems.

CO 2 Solve simple problems based on the knowledge of graphical elements (Line, circle, ellipse) and curves

CO 3 Formulate mathematical equations for parametric and non-parametric representation of surfaces (analytic & synthetic surfaces). Discuss geometric modelling techniques (Half-space, B-rep, Solid modelling).

C0 4 Develop simple programmes for machining operations using the fundamentals of NC, CNC, DNC, Adaptive control systems and.

CO 5 Explain group technology and FMS techniques of computer aided manufacturing and discuss the role and importance of computers in the manufacturing environment.

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:

1. Methods recommended: Two Tests (80%), Written Quiz (10%) and module assignments (10%).
2. The class teacher has to decide the topic for closed book test and Written Quiz. 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 timetable, with common question papers for subject

- The question paper will have ten full questions carrying equal marks.

- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Groover Mikell P. and Zimmers Emory W.(2003) "Computer aided design and manufacturing" Prentice Hall of India , New Delhi.
2. KorenYoram and Ben and Uri Joseph (2005) "Numerical Control of Machine Tools"Khanna Publishers, New Delhi.
3. Zienkiewicz O.C. (1977) "The Finite Element Method" Tata McGraw Hill New Delhi
4. Computer control of Manufacturing System YoramKoren McGraw Hill Intl.Pub.2002.

REFERENCE BOOKS:

1. Ibrahim K Zeid (1998) "CAD/CAM Theory and Practice" Tata McGraw Hill New Delhi
2. Daryl L Logan (2003) "A First Course in Finite Element Method" Pearson Education New Delhi
3. Newman W. and R. Sproull(2005) "Interactive Computer graphics" Tata McGraw Hill New Delhi
4. MikellGroover P., Mitchell Weiss, Roger Nagel N. and Nicholas Odrey G. (1986) "Industrial Robot Technology, Programming and Applications" McGraw-Hill Inc, Singapore.
5. Mechatronics, HMT Ltd., Tata MaGraw Hill Pub.2000.
6. Vince, John (2004), Introduction to Virtual Reality Authors: Vince, Springer-Verlag London

Web links and Video Lectures (e-Resources):

MOOC/NPTEL Resources:

1. http://nptel.ac.in/courses/112102101

Course Articulation Matrix :

Course Code / Name : 21MEE108 / CAD/CAM

Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1			2			1	2	1		1	1		2
CO 2	2	3	1	2	2			1	2	1		1	2		2
CO 3	1	3	2	2	2			1	2	2		1	2		2
CO 4	2	2	2	2	3			1	3	2		1	1		3
CO 5	2	2	2	2	2			1	2	2		1	1		2

1: Low 2: Medium 3: High

Welding Technology			
Course Code	21MEE109	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	3	Exam Hours	3

Course Learning Objectives:

1. Describe the principles of various conventional welding processes. Analyze the set-up and operation in arc welding processes such as SMAW, GMAW and TIG
2. Illustrate the principles of advanced welding processes such as plasma welding, electron beam welding, laser welding. Analyze metallurgical issues associated with welding.
3. Describe and apply various methods of Destructive and Non Destructive testing in weld joint, Inspection & testing. Apply the procedures related to welding joint design.
4. Describe welding distortion and residual stress.
5. Describe overall theoretical aspects for better employability in fabrication/welding application areas and health & safety issues.

UNIT -1

Introduction to Welding processes

Conventional welding and advanced welding processes, Shielded metal arc welding, gas welding and cutting, submerged arc welding, tungsten arc welding, gas metal arc welding, and resistance welding process.

Advanced welding process: Plasma welding, cutting, Metal cladding, electron beam welding, laser beam welding,

Welding Metallurgy

Weldability of carbon steel, weldability of Stainless steel, weldability of non-ferrous materials like titanium and aluminum

15 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT -2

Testing and quality control

Destructive testing, Non-destructive testing such as liquid penetrant inspection, magnetic particle inspection, ultrasonic testing, radiographic testing

Welding Design

Welding symbols, weld joint design, static and fatigue design, distortion and residual stresses. Welding productivity and economics. Expert systems in welding.

15 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT -3

Developments and applications in welding Technology

Welding application to pressure vessel, structures, ship building, and automobile. Welding robots and automation. Introduction to welding codes, ASME code. Precautions for electrical safety, fire hazards, fumes and use of different personal protective equipment for different processes.

09 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 :

CO 1 Describe the principles of various conventional welding processes. Analyze the set-up and operation in arc welding processes such as SMAW, GMAW and TIG.

CO 2 Illustrate the principles of advanced welding processes such as plasma welding, electron beam welding, laser welding. Analyse metallurgical issues associated with welding.

CO 3 Describe and apply various methods of Destructive and Non Destructive testing in weld joint, Inspection & testing.

C0 4 Apply the procedures related to welding joint design. Describe welding distortion and residual stress.

CO 5 Describe overall theoretical aspects for better employability in fabrication/welding application areas and health & safety issues.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

Books

TEXTBOOKS:

1. Welding Engineering and Technology by Dr. R.S. Parmar, Khanna Publishers, ISBN-13: 978-81-7409-028-2, 1374 pages, 2016.
2. A Text-Book of Welding Technology, by O.P. Khanna, Dhanpat Rai Publications; 2013 edition (2011)

REFERENCE BOOKS:

1. Welding handbook by American Welding Society, 9th edition, Volumes 1 to 5.
2. Welding Handbook, American Welding Society, Section-II: Gas Arc and Resistance
3. The Science and Practice of Welding, Vol-2: The Practice of Welding: A. C. Davies, Cambridge University Press (Website: www.cambridge.org).

Course Articulation Matrix :

Course Code / Name : 21MEE109 / WELDING TECHNOLOGY

Course Outcomes (CO)	Program Outcomes (PO)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	2		1	1	1			1	1		1	2	2	
CO 2	3	2		1									1	1	
CO 3	3	2	1	1									1	1	
CO 4	3	2	2	1				1	1	1	1		1	2	
CO 5	3	2	1	1	1	1	1	2	2	1	2	2	2	2	

1: Low 2: Medium 3: High

Computer Integrated Manufacturing

Course Code:	21MEE110	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Understand the process of usage of automation in manufacturing systems.
2. To know the basic elements and also to analyze the production elements.
3. To know how to analyze the automated assembly system.
4. To know the different methods of quality control using computer.
5. Understand the uses and applications of different material handling and storage systems.

UNIT -1

Computer Integrated Manufacturing System: Introduction, Types of automation, Manufacturing support systems, Automation in production systems, Automated manufacturing systems, Computerized manufacturing support systems, Reasons for automating, Production concepts & mathematical models, Automation strategies.

Transfer Lines and Similar Automated Manufacturing Systems: Fundamentals of automated production lines, System configurations, Work part transfer mechanisms, Storage buffers, Storage buffers between two stages of the production line, Control functions, Applications of Automated production lines.

Analysis of Automated Flow: Analysis of transfer lines with no internal storage, Analysis of transfer lines with storage buffers.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Automated Assembly System: Fundamentals of automated assembly systems, System configurations, Parts delivery at workstations, Sign for automated assembly.

Quantitative analysis of assembly systems: Parts delivery at workstations, multi-station automated assembly systems and single station automated assembly systems and partial automation

Computer Aided Quality Control: Contact inspection methods, Non-contact inspection methods, Co-ordinate measuring machine, Automated Storage/Retrieval Systems, Automated guided vehicle systems Types & Applications of AGVs, Vehicle guidance technology, Vehicle management and safety.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Material Handling Systems: Automated storage/retrieval systems (AS/RS) – Introduction, Types & Applications, Reasons for installing AS/RS, Carousel storage system.

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:

CO 1 Apply engineering specialization & analysis for solution on managing the production system

CO 2 Conduct investigation on problems on production system for betterment of engineering society.

CO 3 Understand the impact of management on the industrial environment and ethics.

CO 4 Function effectively in managing the industrial management as individual & team with better communication.

CO 5 To effectively manage the activities of the industrial environment to assist in project management and financial activities with scope of lifelong improvement.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

REFERENCE BOOKS

1. M.P. Grover. “Automation, Production Systems & Computer Integrated Manufacturing” Prentice Hall, third edition, 2008.
2. Groover Mikell P. and Zimmer Emory W. (2003) “Computer Aided design and Manufacturing” Prentice Hall Publications, New Delhi
3. CAD/CAM Principles and Applications, Rao P.N. Tata McGraw Hill, Second Edition, 2004.
4. Principles of Computer Integrated Manufacturing- Vajpayee S.Kant. Prentice Hall of India, New Delhi,1999.

Web links and Video Lectures (e-Resources):

1. https://www.elsevier.com/books/computer-integrated-manufacturing/weatherall/978-0-408-00733-7
2. https://archive.nptel.ac.in/courses/112/104/112104289/.
3. https://mooc.es/course/computer-integrated-manufacturing/

Course Articulation Matrix :

Course Code / Name : 21MEE110/ COMPUTER INTEGRATED MANUFACTURING															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	3	1	2	1	2	3	3	3	3	2	1	3
CO 2	2	2	2	2	1	2	1	2	3	3	3	3	1	1	2
CO 3	2	2	2	2	1	2	1	2	3	3	3	3	2	1	2
CO 4	2	1	2	2	1		1	2	2	3	3	2	2	1	2
CO 5		1	1	1	1		1	2	2	3	3	2	2		

Additive Manufacturing

Course Code	21MEE111	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Understand the importance of AM in manufacturing and understand the workflows for AM of polymers and metals.
2. Understand the technical principles of different AM process.
3. Design parts for AM by combining process knowledge, computational design tools, and application requirements.
4. Plan the process for additive manufacturing of part based on processes, materials, application production cost, and performance
5. Understanding on different post processing of AM parts and applications of AM in different fields

UNIT -1

Introduction: Introduction to AM, AM evolution, Distinction between AM & subtractive manufacturing, Advantages of AM. AM process chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build removal and clean up, post processing.

Classification of AM processes: Liquid AM- VAT Photopolymerization, Material jetting, Binder jetting, Powder-based AM processes (selective laser sintering, shaping, electron beam melting. involvement), Solid-based AM processes - extrusion based fused deposition modeling object, Sheet AM, Wire additive manufacturing, Stereolithography, Micro- and nano-additive manufacturing.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation, Video demonstrations or simulations, Laboratory demonstrations and practical experiment

UNIT -2	
Design for AM: DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, part orientation, removal of Supports, hollowing out parts, Inclusion of undercuts and other manufacturing constraining features, interlocking features, reduction of part count in an assembly, identification of markings/ numbers etc. **Materials for AM:** Different materials used, use of multiple materials, multifunctional and graded materials in AM, Role of solidification rate, evolution of non-equilibrium structure, structure-property relationship, grain structure and microstructure. **Process Selection and planning:** Selection of AM technologies using decision methods, AM process planning, monitoring and control **15 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation, Video demonstrations or simulations, Laboratory demonstrations and practical experiment
UNIT -3	
Post processing of AM parts: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques. **AM Applications:** Functional models, Pattern for investment and vacuum casting, medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries **09 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation, Video demonstrations or simulations, Laboratory demonstrations and practical experiment
Course outcome (Course Skill Set) **At the end of the course the student will be able to :** **CO 1** Demonstrate the importance of additive manufacturing in engineering design and manufacturing **CO 2** Differentiate between different additive manufacturing process and **CO 3** Understand the workflow in additive manufacturing by applying the knowledge, omputational design tools, and application requirements. **C0 4** Understand the methodology to additive manufacturing of part based on processes, materials, application production cost, and performance **C0 5** Demonstrate different post processing of AM parts and applications of AM in different fields	

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rdEd., 2010
2. D.T. Pham and S.S. Dimov, "Rapid Manufacturing", Springer, 2001
3. Terry Wohlers, " Wholers Report 2000", Wohlers Associates, 2000
4. Paul F. Jacobs, " Rapid Prototyping and Manufacturing"–, ASME Press, 1996
5. Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer, 2nd Ed, 2014.

Web links and Video Lectures (e-Resources):

1. Fundamentals of Additive Manufacturing Technologies, IIT Guwahati, Prof. Sajan Kapil https://nptel.ac.in/courses/112103306

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

1. Demonstration of working principle and process involved in FDM
2. Demonstration of wire arc additive manufacturing

Course Articulation Matrix :

Course Code / Name : 21MEE111 / ADDITIVE MANUFACTURING

Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2				2	1	1	1	1	3		
CO 2	2	3	3	3				3	1	1	1	1	3		
CO 3	3	3	2	3				1	1	1	1	1	3		
CO 4	3	3	2	2				1	1	1	1	1	3		
CO 5	2	2	2	3				2	1	1	1	1	2		

1: Low 2: Medium 3: High

Total Quality Management			
Course Code:	21MEE112	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

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

UNIT -1

Introduction: The Meaning of Quality and Quality Improvement; Statistical Methods for Quality Control and Improvement; TOTAL Quality Management: Definition, Principles of TQM, Gurus of TQM, Benefits of TQM. Principles of TQM: Leadership - Deming's philosophy, Customers' satisfaction - Customers perception, Feedback, Employee involvement - quality circles, Continuous Improvement- Juran's Trilogy, PDSA cycle, Kaizen, Six sigma, ISO-9000, ISO-14000, ISO-18000 series of standards.

Modeling Process Quality: Mean, Median, Mode, Standard deviation, calculating area, Normal distribution tables, Finding the Z score, Central limit theorem, 7 QC tools.

Methods and Philosophy of Statistical Process Control: Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL).

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16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Control Charts for Variables: Control Charts for X-Bar and R- Charts, Type I and Type II errors, the probability of Type II error. Simple Numerical Problems.

Process Capability: The foundation of process capability, Natural Tolerance limits, cp – process capability index, cpk, pp – process performance index, summary of process measures. Numerical problems.

Control Charts for Attributes: Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non-conformities per UNIT . Numerical problems

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Lot-By-Lot Acceptance Sampling for Attributes: The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, AOQL, LTPD, OC curves, Numerical problems.

Introduction to Design of Experiments: Hypothesis testing, one sample t-test, orthogonal design of experiments, two factor experimental design, numerical problems on the above topics.

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:

CO 1 Understand the concept of quality and evolution of quality concepts over the years

CO 2 Apply statistical concepts for solving simple quality problems.

CO 3 Draw and analyze control charts for variables.

CO 4 Draw and analyze the control chart for attributes.

CO 5 Understand the basic concepts of Acceptance Sampling and Design of experiments.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Statistical Quality Control: E.L. Grant and R.S. Leavenworth, 7th edition, McGraw- Hill publisher, 2004.
2. Statistical Quality Control: RC Gupta, Khanna Publishers, New Delhi, 3rd edition, 2005.
3. Total Quality Management: Dale H. Besterfield, Pearson Education, 3rd edition, 2011.

REFERENCE BOOKS

1. Statistical Process Control and Quality Improvement: Gerald M. Smith, Pearson Prentice Hall. ISBN 0 – 13-049036-9.
2. Statistical Quality Control for Manufacturing Managers: W S Messina, Wiley & Sons, Inc. New York, 1987
3. Statistical Quality Control: Montgomery, Douglas, 5th Edition, John Wiley & Sons, Inc. 2005, Hoboken, NJ (ISBN 0-471-65631-3).
4. Principles of Quality Control: Jerry Banks, Wiley & Sons, Inc. New York.
5. Design and Analysis of Experiments: R. Pannerselvam, PHI Learning Private Limited, New Delhi., 2012
6. Operations Management-Theory and Practice, B Mahadevan, Pearson Education, 2007.
7. Production / Operations Management, R. Pannerselvam, PHI India, 2011.

Web links and Video Lectures (e-Resources):

1. NPTEL course material related to operations management, TQM

Course Articulation Matrix :

Course Code / Name : 21MEE112 / TOTAL QUALITY MANAGEMENT															
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
CO 2	2	1									1				1
CO 3	3	2									3				3
CO 4	3	2									3				3
CO 5	3	2									3				3

1: Low 2: Medium 3: High

Maintenance & Reliability Engineering			
Course Code:	21MEE113	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Get an idea on different types of maintenance done
2. Develop interest in maintenance planning and control over maintenance.
3. Understand the implementation of RCM and TPM in maintenance.
4. Gain knowledge on reliability engineering.
5. Present importance of reliability and its implementation in mechanical applications.

UNIT -1	
Introduction: Need for maintenance, objectives, functions and importance of maintenance systems, Type of maintenance systems – planned, breakdown, preventive, predictive, design-out, corrective, opportunistic, Total Productive Maintenance Condition based maintenance – condition monitoring Computers in maintenance – introduction, features and benefits **Maintenance planning and Scheduling:** Planning of maintenance functions, manpower allocation, long range planning, short range planning, planning techniques and procedures, estimation of maintenance work, maintenance control, scheduling, objectives and stages of manpower planning, timescale of manpower planning, manpower for maintenance systems, Effective utilization of manpower, spare parts management, spares control. **16 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT -2	
Reliability Centered Maintenance: Introduction, Functions, Functional Failures, Failure Modes and Effects Analysis (FMEA), Failure Consequences, Proactive Maintenance, Failure Finding, Default Actions **Total Productive Maintenance:** Introduction, Development of Maintenance Systems, Pillars of TPM, Toyota Production System, TPM basic use and Ideal Conditions, Creating Standards and Preparation for Autonomous Maintenance, 5S. **Introduction to Reliability:** Definition, failure data analysis – introduction, failure data, MTTF, MTBF, Hazard model – introduction, Weibull model, some important distributions Numerical problems required. **16 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT - 3	
System reliability: Introduction, series, parallel, mixed configuration, series-parallel, parallel-series configurations, methods of solving complex systems. Reliability improvement – introduction, improvement of components, redundancy – types, optimization, reliability cost trade off Maintainability and Availability – introduction, reliability and maintainability trade off. **07 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:** **CO 1** Apply the knowledge of engineering fundamentals to different types of maintenance and basics of condition monitoring. **CO 2** Demonstrate knowledge on maintenance planning and scheduling along with manpower planning to manage projects in multidisciplinary environments. **CO 3** Create, select and apply the concept of reliability centered maintenance and total productive maintenance to complex engineering activities with an understanding of the limitations. **CO 4** Understand the impact of reliability and failure models and demonstrate the knowledge of different hazard models.	

CO 5 Use research-based knowledge to understand the system reliability and reliability improvement of data to provide valid conclusions.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Reliability and Maintenance Engineering by R. C. Mishra, New Age International, 2006.
2. Maintenance Engineering and Management by R.C.Mishra and K.Pathak, Prentice Hall of India, 2012.
3. Maintenance Engineering Handbook by Higgins and Morrow, Tata McGraw Hill, 1985.
4. Reliability Engineering by L.S.Srinath, Affiliated East West Press Pvt. Ltd., 2005..
5. Reliability Centered Maintenance by John Moubray, industrial Press Inc. 2nd Edition
6. Total Productive Maintenance by Steven Borris, McGraw Hill, 2006

REFERENCE BOOKS:

1. Mechanical Fault Diagnosis and Condition Monitoring by R.A.Collacott, McGraw Hill, 1985.
2. Management of Industrial Maintenance by Kelley A., and Harris, M.J., Newnes-Butter worth.
3. Maintenance Engineering Handbook by Morrow, 2002.

Web links and Video Lectures (e-Resources):

Course Articulation Matrix :

Course Code / Name : 21MEE113 / MAINTENANCE & RELIABILITY ENGINEERING															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
CO 1	3	1	1	1	1	2	2	1	2	2	1	3	2	3	
CO 2	1	2	3	2	2	3	3	3	3	3	3	3	3	3	
CO 3	3	3	3	3	3	3	1	3	3	3	3	3	3	3	
CO 4	1	3	2	3	2	3	3	2	1	2	1	3	2	3	
CO 5	3	3	3	3	2	2	2	3	2	2	1	3	1	3	
1: Low 2: Medium 3: High															

INTRODUCTION TO MACHINE LEARNING			
Course Code:	21MEE114	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Know the fundamentals of machine learning, its relationship with artificial intelligence, linear models for classification
2. Appreciate the use of neural networks
3. Know about support vector machines and its application
4. Provide an overview about deep learning.
5. Know the application of different machine learning techniques in real life applications

UNIT -1

Introduction to machine learning - need, applications, advantages and limitations. What is Artificial Intelligence? Difference between AI and ML, case study examples. Decision trees, Regression, Probability theory / distributions.

Introduction to Neural networks- learning theory, classification, advantages, limitations, applications, feed forward networks, network training, Bias / variance tradeoff, generalization errors, model selection, VC dimensions

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Multilayer perceptron - Characteristics, error back propagation algorithm, XOR Problem, Sequential and batch modes of learning, Generalization, Case study on Multilayer perceptron

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 , regularization and stability , Case study on Radial basis function neural networks.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Support Vector Machines and Kernel methods –Introduction, statistical learning theory, 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, Case study on Support Vector Machines

Other topics - Introduction to relevant vector machines (RVM), difference between RVM and SVM, Introduction to Deep Learning Introduction to Convolutional neural network

8 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:

CO 1 Explain about machine learning, identify its relation with artificial intelligence, apply linear models for classification and identify issues related to machine learning algorithms.

CO 2 Explain learning theory, classification, advantages, limitations, applications, feed forward networks

CO 3 Explain multi-layer perceptron in terms of its architecture, features, principle, advantages, disadvantages and applications and solve simple problems

CO 4 Explain radial basis function network in terms of its architecture, features, principle, advantages, disadvantages and applications and solve simple problems

CO 5 Explain support vector machines in terms of its principle, features, advantages, disadvantages and applications. Explain about relevant vector machines and differentiate it from support vector machines, Convolutional neural network and deep learning

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

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

REFERENCE BOOKS

1. Goodfellow, I., Bengio, Y., Courville, A., Deep Learning, Part II, MIT Press, 2016.
2. Vapnik, V., An Overview of Statistical Learning Theory, IEEE Transactions on Neural Networks, Vol. 10, pp. 988-999, 1999.
3. Christopher Burges, A Tutorial on Support Vector Machines for Pattern Recognition, Data Mining and Knowledge Discovery, 1998.
4. Kurt Hornik, Maxwell Stinchcombe and Halbert White, Multilayer Feedforward Networks are Universal Approximators, Neural Networks, 1989.

Web links and Video Lectures (e-Resources):

1. https://www.my-mooc.com/en/categorie/machine-learning
2. https://onlinecourses.nptel.ac.in/noc21_cs70

Course Articulation Matrix :

Course Code / Name : 21MEE114/ INTRODUCTION TO MACHINE LEARNING															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1			2						2			
CO 2	3	2	1			2						2			
CO 3	3	2	1			1						2			
CO 4	3	2	1			1						2			
CO 5	3	2	1			1						2			
1: Low 2: Medium 3: High															

OPERATIONS RESEARCH			
Course Code:	21MEE115	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Formulate and solve problems using graphical and simplex linear programming techniques
2. Determine optimal solutions to a transportation problem using modified distribution method. Find the optimal solution for an assignment problem using Hungarian Approximation Method
3. Solve sequencing problems using Johnson's algorithm and graphical method. Determine replacement policy for equipment which deteriorates gradually and for items that fail suddenly.
4. Develop a simulation model using Monte Carlo technique and solve the problem. Solve two-person game to determine strategies in conflict situations depicted in problems.
5. Construct network diagrams determine critical paths and float time. Analyze time cost trade off using crashing technique. Estimate expected project duration and variance using Program evaluation and review technique.

UNIT -1

Introduction -Definition, scope of Operations Research (OR) approach, advantages, and limitations of OR models, applications, Characteristics, and phases of OR.

Linear Programming- I – Formulation and Graphic Solution –Introduction, mathematical formulation of Linear Programming Problems (LPP), Graphical Solution. Simplex Method –Introduction, Simplex method – slack, surplus and artificial variables

Transportation Problem -Introduction, formulation of transportation model, Basic feasible solution using different methods, Optimality method, Unbalanced transportation problem, Applications

Assignment Problem – Formulation, Balance, unbalanced assignment problem, Maximization problem.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Sequencing – Introduction, the sequencing problem, Johnson's algorithm, n-jobs on 2 machines, n-jobs on 3 machines, n-jobs on m machines, 2 jobs on n machines, graphical solution, priority rules

Replacement Theory –Introduction, replacement policy for equipment which deteriorates gradually

Simulation –Introduction, process of simulation, Monte Carlo Simulation, Problems on simulation

Game Theory- Introduction, Game models, Two-Person Zero-Sum games and their solution, Games with and without saddle point, dominance property, Graphical solution (2Xn, mX2 games)

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Project Management using Network Analysis – Introduction, Network construction, determining critical path, floats, scheduling by network, project duration, PERT – estimation of project duration, variance under probabilistic models, prediction of date of completion, Crashing of networks, least cost project scheduling

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:

CO 1 Formulate and solve problems using graphical and simplex linear programming techniques

CO 2 Determine optimal solutions to a transportation problem using modified distribution method. Find the optimal solution for an assignment problem using Hungarian Approximation Method

CO 3 Solve sequencing problems using Johnson's algorithm and graphical method. Determine replacement policy for equipment which deteriorates gradually and for items that fail suddenly.

CO 4 Develop a simulation model using Monte Carlo technique and solve the problem. Solve two-person games to find the strategies in conflict situations depicted in problems.

CO 5 Construct network diagrams determine critical paths and float time. Analyze time cost trade off using crashing technique. Estimate expected project duration and variance using Program evaluation and review technique.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw-Hill Publishing Company Limited, Third Edition, 2008
2. Prem Kumar Gupta and D.S. Hira, Operations Research, S. Chand Publications, 2009.

REFERENCE BOOKS

1. Problems in Operations Research (Principles and Solutions), Prem Kumar Gupta, D S Hira- S. Chand & Company LTD, New Delhi 4th edition 2009
2. Operations Research an Introduction, Taha H. A. 8th edition – Pearson Education 2007
3. Operations Research, S. D. Sharma -Kedarnath Ramnath & Co 2002.
4. PERT & CPM", L. S. Srinath, New Delhi, 3rd edition 2001

Web links and Video Lectures (e-Resources):

1. NOC:Introduction to Operations Research, IIT Madras, Prof. G. Srinivasan, https://nptel.ac.in/courses/110106062
2. VTU e-learning EDUSAT Operations Research Course material for B.E and MBA.

Course Articulation Matrix :

Course Code / Name : 21MEE115/ OPERATIONS RESEARCH															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	3	1						1	1					2
CO 2	1	3	1						1	1	2				2
CO 3	1	3	1						1	1	2				3
CO 4	1	2	1						1	1	2				3
CO 5	1	3	1						1	1	3				2
1: Low 2: Medium 3: High															

Introduction to Piping Engineering			
Course Code:	21MEE117	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. To know the fundamentals of piping and pipe components.
2. Study the types and purpose of different valves
3. To get an understanding of cylinders and pipe thickness calculation.
4. To get the thorough understanding of drawing associated with piping.
5. Classify different loads acting on pipe

UNIT -1

Scope of piping engineering, major phases in life cycle of a chemical process, Introduction to Piping, Fundamentals of piping, Classification of pipe, Pipe Manufacturing Methods, Pipe Sizes, Pipe Schedule & Pipe Representation.Codes and standards. Types of pipes. Material selection for pipe, pipe size, wall thickness.

Piping Components, Piping Fittings, Types of Flanges, Types of Valves, Speciality Items. Functions of valves.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2	
Thick and thin cylinders. Hoop stress, pipe thickness calculations. Piping arrangements, pipe rack layout, types of racks, width calculation. Basics of piping and equipment layout, piping symbols, plans and isometrics. General Arrangement Drawing, Process and Instrumentation Drawing. Classification of tanks. 16 Hours	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT - 3	
Pipe under stress, classification of loads and failures. Theories of failure. Methods of flexibility analysis, pipe supports. 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:

CO 1 Understand fundamentals of piping and do the pipe representation

CO 2 Identify different components of piping system and working of valves.

CO 3 Understand the different piping arrangements and perform thickness calculations.

CO 4 Understand and draw different types of piping layouts.

CO 5 Analyze the different loads acting on the pipe.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Mohinder L Nayyar “Piping Hand book”

REFERENCE BOOKS

1. Henry H. Bender, “Pressure Vessels, Design Hand Book", CBS Publishers and Distributors, 1987.
2. Stanley, M. Wales, "Chemical Process Equipment, Selection and Design. Butterworth’s series in Chemical Engineering", 1988.

Web links and Video Lectures (e-Resources):

Course Articulation Matrix :

Course Code / Name : 21MEE117/ INTRODUCTION TO PIPING ENGINEERING															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1		1	3	2	1	2	1	1	1	1	1	2	1	2	
CO 2	3	3				2		1	1	2		2	2	2	
CO 3	2	3							1		3			1	
CO 4	2	2							1	3				1	
CO 5	3	3	2	2	2	2			1	3		1		1	

1: Low 2: Medium 3: High

INDUSTRIAL TRIBOLOGY			
Course Code:	21MEE118	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Explain about the types of lubricants, their properties and method to determine the properties. To obtain the equation of flow through pipe and through parallel plates.
2. To recollect the phenomenon of friction and the theories of friction. To discuss the effect of friction on component life.
3. To give details about the selection of materials and surface treatment methods such as heat treatment, carburizing, nitriding, and surface coating techniques such as hard facing and vapour deposition method that improve the wear resistance of the surface.
4. Explain the mechanism of pressure development in oil film. To derive the Reynolds equation and discuss its importance.
5. To provide details about hydrostatic lubrication. To derive the equations used to determine the load carrying capacity, oil flow and power loss in hydrostatic step bearing.

UNIT -1	
Introduction: Introduction to Tribology, lubricants – Properties of lubricants, viscosity, Newton's Law of viscosity, Hagen-Poiseuille law, Flow between parallel stationary planes, viscosity measuring apparatus, effect of temperature and pressure on viscosity. **Hydrodynamic lubrication** : Mechanism of pressure development Tower's Experiments Reynold's equation in two dimensions, working of Partial and full journal Bearing, Load carrying capacity, Friction forces and power loss in lightly loaded bearing. **15 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT -2	
Friction: Introduction, laws of friction, types of friction – sliding, rolling, friction of metals, friction of ceramics, polymers, stick-slip, topography of engineering surfaces, contact between surfaces. **Wear**: Introduction, types of wear mechanisms – adhesive, abrasive, fatigue, impact, corrosive wear, wear of materials – metals and alloys, ceramics, polymers, wear measurement, Effect of speed, temperature and pressure, Commonly used bearing materials, properties of typical bearing materials. **10 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT - 3	
Slider/pad bearing with fixed and pivoted shoe: Pressure distribution, Load carrying capacity, Coefficient of friction, frictional resistance in a fixed shoe and pivoted shoe bearing, influence of end leakage, numerical problems, idealized full journal bearings, Partial journal bearing, Numerical problems. **Hydrostatic Lubrication** : Introduction, Hydrostatic step bearing – load carrying capacity, oil flow, stiffness, and numerical problems. **14 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:** **CO 1** Recall the concepts related to the flow of fluids and illustrate the use of lubrication and lubricants. **CO 2** Interpret frictional behavior in metals and nonmetals. **CO 3** Discuss different types of wear and apply various surface treatment methods. **CO 4** Discuss the different types of lubrication and types of bearings, their design and performance. **CO 5** Derive analytical expressions related to the design and performance of hydrostatic bearings.	

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Introduction to Tribology of Bearings – B.C. Majumdar, S. Chand & Company Ltd., New Delhi, 2008.
2. Principles and Applications of Tribology – Bharat Bhushan, John Wiley and Sons Inc., 1999.
3. Tribology in Industries – Sushil Kumar Srivastava, S. Chand & Co. Ltd., New Delhi, 2001.

REFERENCE BOOKS

1. Lubrication of bearings – Theoretical Principles and Design, Redzimovskay E.I., Oxford Press Company.
2. Engineering Tribology, Prasanta Sahoo, PHI Learing Pvt. Ltd., New Delhi.
3. Fundamentals of Tribology, S.K. Basu, S.N. Sengupta and B.B. Ahuja, PHI Learing Pvt. Ltd., New Delhi

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/112102014

Course Articulation Matrix :

Course Code / Name : 21MEE118/ INDUSTRIAL TRIBOLOGY															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	2	0	0	1	1	1	0	0	0	1	1	2	
CO 2	2	3	2	0	0	1	1	1	0	0	0	1	1	2	
CO 3	2	3	2	0	0	1	1	1	0	0	0	1	1	2	
CO 4	1	2	3	0	0	1	0	0	0	0	0	1	0	3	
CO 5	1	3	2	0	0	1	0	0	0	0	0	1	0	1	

1: Low 2: Medium 3: High

ENERGY MANAGEMENT			
Course Code	21MEE119	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	3

Course Learning Objectives:

1. Know fossil fuel reserves in India, energy requirements in future, the need for energy conservation and management and various energy conservation methods.
2. Understand the concept of energy auditing, duties and responsibilities of energy manager
3. Understand waste heat recovery and cogeneration concepts..
4. Understand the principal pollutants due to domestic, transport and industries, greenhouse effect, acid rain, global warming.
5. To know about Kyoto protocol, carbon trading, carbon fund, energy rating, green rating.

UNIT -1

Classification of energy sources, Indian energy scenario with respect to commercial sources.

Energy efficiency benefits, methods of energy conservation, simple energy conservation methods applicable to domestic, transport, agricultural and industrial sectors.

Energy Management**:** Definition, objectives, Organizing energy management in Industries. Organizational set up for energy management, Functions of energy manager.

Energy Audit**:** Elements and concepts, Types of energy audits, Instruments used in energy auditing.

15 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT -2

Boiler and Furnace Audit **,**Efficient use of steam in boiler distribution system

Waste Heat Recovery: Potential, benefits, waste heat recovery equipments -recuperators, heat wheels, heat pipe, waste heat boilers, heat pumps.

Cogeneration: types of cogeneration systems.

15 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT -3

Principal pollutants due to domestic, transport and industries , greenhouse effect, acid rain, global warming,

Kyoto protocol, carbon trading, carbon fund, energy rating, green rating.

09 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

CO 1 Classify energy sources. Describe the Indian energy scenario and calculate the lifetime of the availability of the reserves. Explain the no cost/low cost energy conservation methods applicable to domestic, transport, agricultural and industrial sectors.

CO 2 Illustrate energy management and energy audit and conduct mini energy audit for domestic appliances and lighting in industries. Explain the duties and responsibilities of energy manager

CO 3 Analyze the energy losses in boilers and furnaces, list low cost conservation methods in boilers and furnaces and explain the utilization of steam efficiently in boiler houses and compute the quantity of flash steam and heat content recovered.

CO 4 Explain waste heat recovery and cogeneration and compute cogeneration efficiency.

CO 5 Outline the major air pollutants and explain greenhouse effect, acid rain, kyoto protocol, carbon trading, energy rating, and green rating.

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:

TEXTBOOKS:

1. Energy management, WR Murphy and G Mc Kay Oxford university Press(2009)
2. Energy Management Handbook - 7th Edition - Wayne C. Turner , Steve Doty , Wayne C. Truner 2009

REFERENCE BOOKS:

1. Design and Management for energy conservation by Callaghn P W , Pergamon, oxford ,1981
2. Energy conservation in Process Industry—W.F.Kenny(1984)
3. Energy Engineering and Management- Amlan Chakrabarti-Prentice hall India 2011
4. Energy Management Principles C Smith-Pergamon Press,New York 1981
5. Bureau of energy efficiency Hand outs New Delhi

Web links and Video Lectures (e-Resources):

1. https://beeindia.gov.in/
2. https://en.wikipedia.org/wiki/Bureau_of_Energy_Efficiency

Course Articulation Matrix :

Course Code / Name : 21MEE119 / ENERGY MANAGEMENT															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2				2	2	1	1	1		1	1	2	1
CO 2	3	3				2	2	1	1	1		1	1	3	1
CO 3	3	3				2	3	1	1	1		1	1	3	1
CO 4	3	2				2	2	1	1	1		1	1	3	1
CO 5	3	2				2	2	1	1	1		1	1	3	1
1: Low 2: Medium 3: High															

Operations Management			
Course Code:	21MEE121	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Understand the functions of various types of business organizations, Recognize the importance of operations function, apply important tools of Decision making in an organization setting.
2. Apply different methods of forecasting and solve numerical problems.
3. Analyze capacity and location planning and plant layout problems and Select best possible capacity, location and layout given the resources and information
4. Understand the nature and scope of, various strategies and techniques of aggregate planning and Master Scheduling. Apply these strategies to arrive at the best aggregate plan and MPS.
5. Discuss Material requirements planning and solve numerical problems. Generate Material requirement plan, with the available information.

UNIT -1

Production and Operations Management: Introduction, Functions within business organizations, the operation management function, Classification of production systems, Productivity, factors affecting productivity,

Decision Making: The decision process, characteristics of operations decisions, use of models - B.E.P and Transportation models, decision making environments. Decision trees.

Forecasting: Steps in forecasting process, approaches to forecasting, forecasts based on judgment and opinion, analysis of time series data, Regression and Correlation methods, accuracy and control of forecasts, Choosing a forecasting technique, Elements of a good forecast.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Capacity, Location and Layout Planning: Importance of capacity decisions, defining and measuring capacity, determinants of effective capacity, determining capacity requirement, developing capacity alternatives, evaluating alternatives.

Design, System an actual capacity. System efficiency and utilization. Determination of Equipment requirement for a single stage production processes. Numerical problems on the above.

Need for location decisions, nature of locations decisions, general procedure for making locations decisions, evaluating locations decisions. Use of Break even analysis and Transportation algorithms for making location decisions. Facilities layout - Need for layout decisions. Minimizing material handling cost in process layout using Load distance analysis, Simple line balancing problems in product layouts.

Aggregate Planning & Master Scheduling: Aggregate planning - Nature and scope of aggregate planning, strategies of aggregate planning, techniques for aggregate planning - graphical and charting techniques, Mathematical techniques. The master production schedule, Master scheduling process, Master scheduling methods.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3	
Material Requirement Planning (MRP): Dependent versus independent demand, an overview of MRP - MRP inputs and outputs, MRP processing: An overview of MRP-II, JIT manufacturing and ERP, benefits and limitations of MRP. Capacity requirement planning 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:

CO 1 Describe the process of operations management. Apply Break Even Analysis, Expected Monetary Valve (EMV) and decision tree methods of decision making to select optimal decision alternative.

CO 2 Apply moving average, least squares, exponential smoothing and regression and correlation methods of forecasting to estimate the trend in demand when past sales/ independent variables are given. Apply the Seasonal Indexes to adjust the trend values. Estimate the forecast error and determine the forecast accuracy from the given data.

CO 3 Determine the design capacity, system capacity and system efficiency. Determine optimal facility location using Break even analysis and Transportation Method. Apply the method of transportation and load distance analysis to select optimal process plant layout. Apply the line balancing principles to determine cycle time and optimal grouping of machines in product layouts.

CO 4 Compare pure and mixed Aggregate planning strategies to determine the best aggregate plan. Determine the Master Production Schedule (MPS) considering the inventory and demand data.

CO 5 Develop a material requirement plan, based on the available information on .Bill of materials, Inventory data and Master Production Schedule.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Production and Operations Management, William J Stevenson, Tata McGraw Hill, 8th Edition. 2011
2. Production / Operations Management, Joseph G Monks, McGraw Hill Books, 2001

REFERENCE BOOKS

1. Production and Operations Management, Norman Gaitmer & Greg Frazier,2011
2. Operations Management for Competitive Advantage, R.B.CHase, NJ.Aquilino, F. Roberts Jacob; McGraw Hill Companies Inc., Ninth Edition.
3. Production & Operations Management, Everett E.Adams, Ronald J.Ebert, Prentice Hall of India Publications, Fourth Edition. 2001
4. Operations Management-Theory and Practice, B Mahadevan, Pearson Education, 2007.
5. Production / Operations Management, R. Pannerselvam, PHI India, 2011.

Web links and Video Lectures (e-Resources):

1. NPTEL course material related to operations management, TQM, operations research

Course Articulation Matrix :

Course Code / Name : 21MEE121 / OPERATIONS MANAGEMENT															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	3								2				1
CO 2	3	2	2								2				1
CO 3	1	2	3								2				2
CO 4	2	3	2								2				2
CO 5	2	2	3			1	2	1			2				2
1: Low 2: Medium 3: High															

Human Resource Management			
Course Code	21MEE122	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. To develop a meaningful understanding of HRM theory, functions and practices.
2. To understand concepts and skills recruitment.
3. To understand the concepts of training and development.
4. To deal with employees' grievances, safety and health types of organizations.
5. To understand the concepts of e-HRM.

UNIT -1

Human Resource Management & HRP:
Introduction, meaning, nature, scope of HRM. Major functions of HRM, Personnel Management vs Human Resource Management, job design, job evaluation, job analysis, job specification, job enlargement, job enrichment. Role of HR Manager.HR Planning. Process HRP.

Recruitment: Definition, Sources and Methods of Recruitment
Selection: Definition and Process of Selection. Cost benefit analysis of selection.
Placement: Meaning, Induction/Orientation, Internal Mobility, Transfer, Promotion, Demotion and Employee Separation. Performance Appraisal methods

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Training and development: Training v/s development, stages in training, Training Methods, Executive Development, Methods and Development of Management Development, Career and Succession Planning.
Compensation: employee remuneration, rewards, Wage and Salary Administration, Bonus, fringe benefits.
Internal Mobility, External Mobility, Trade union Act (Amendment) 2001.
Employee Grievances: Employee Grievance procedure. Discipline procedure
Collective bargaining; Characteristics, Necessity, Forms
Safety & Health; Industrial accidents, Safety
Quality circle; Meaning, Structure **15 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -3

IHRM. Managing IHRM. e-HR Activities, Global recruitment, selection, expatriates. Industrial conflict – Causes, Types, Prevention and Settlement.
e-HRM; Aspects of e-HRM,e-Job design & Analysis, Ethical issues in employment **08 Hours**

Pedagogy	Chalk and talk method, Power Point Presentation

Course outcome (Course Skill Set)

At the end of the course student will be able to

CO 1 Describe the basic concepts of HRM & HRP.

CO 2 Elucidate the HRM functions of recruitment, selections, and appraisal.

CO 3 Apply the training, development and compensation methods in HRD.

CO 4 Identify the employee grievances to spell out the remedial measures.

CO 5 Infer the concepts of e-HRM and I-HRM.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS

1. Essentials of Human Resource Management & Industrial Relations-P Courseba Rao, Third Revis Edition

REFERENCE BOOKS:

1. Human Resource Management - John M. Ivancevich, 10/e, McGraw Hill.
2. Human Resource Management-Flippo
3. Human Resource Management - Lawrence S. Kleeman, Biztantra , 2012.
4. Human Resource Management – Aswathappa K HPH

Web links and Video Lectures (e-Resources):

1. http://edx.nimt.ac.in/courses/course-v1:nimtX+PGDM1212+2017_H1/about
2. http://nptel.ac.in/courses/122105020/

Course Articulation Matrix :

Course Code / Name : 21MEE122/ HUMAN RESOURCE MANAGEMENT															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO 1	3					1			1	1		1			1
CO 2	3					1			1	1		1			1
CO 3	3					1			1	1		1			1
CO 4	3					1			1	1		1			1
CO 5	3					1			1	1		1			1

1: Low 2: Medium 3: High

Marketing Management			
Course Code:	21MEE123	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Understand and learn the marketing concepts and their application to profit-oriented and 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 -1

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.

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

14 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2	
PRODUCT PRICING & MARKETING RESEARCH Objectives, pricing, Decisions and Pricing methods, Pricing Management. Introduction, Uses, process of Marketing Research. **MARKETING PLANNING & STRATEGY FORMULATION** Components of a marketing plan, strategy formulations and the marketing process, implementation, Portfolio analysis, BCG, GEC grids. **14 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT - 3	
ADVERTISING, SALES PROMOTION & DISTRIBUTION Characteristics, Impact, goals, types, Sales promotion-Point of Purchase, Unique Selling proposition. Characteristics, Wholesaling, Retailing, channel design, logistics, Modern Trends in retailing. **11 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:

CO 1 Explain the basic marketing concepts.

CO 2 Interpret the buying behaviour of customers and role of marketing segments

CO 3 Explain the role of product pricing and marketing research in the competitive global business environment

CO 4 Analyse the marketing plans and strategies.

CO 5 Explain the role of sales, advertising and distribution in marketing to achieve the goals of marketing

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:

3. Methods recommended: Two Tests (80%), Written Quiz (10%) and module assignments (10%).
4. 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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

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.

Web links and Video Lectures (e-Resources):

1. https://www.bing.com

Course Articulation Matrix :

Course Code / Name : 21MEE123 / MARKETING MANAGEMENT															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3						1	1	1	1					
CO 2	3						1	1	1	1			1		1
CO 3	3						1	1	1	1	2		1		1
CO 4	2	3					1	1	1	1			1		1
CO 5	3						1	1	1	1			1		1
1: Low 2: Medium 3: High															

GROUP-II

Advanced Strength of Materials

Course Code:	21MEE201	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Understand the concept of stress and determine the stress components.
2. Understand and determine the components of strains and the stress-strain relations.
3. Carry out analysis of two-dimensional problems in Cartesian co-ordinates.
4. Solve two-dimensional problems in polar co-ordinates.
5. Understand the concepts of torsion and viscoelasticity.

UNIT -1

Introduction to Stress: Definition and notation for forces and stresses, body force, surface force, components of stresses, equations of equilibrium, specification of stress at a point- stress tensor, deviatorial and spherical stress tensors, Cauchy's equations and principal stresses, stress invariants, boundary conditions, stress transformation, Octahedral stresses.

Introduction to Strain: Deformation, strain displacement relations, strain components, state of strain at a point, principal strains, strain invariants, strain transformation, compatibility equations, spherical and deviatorial strain tensors. **General equations of Elasticity:** Generalized Hooke's law in terms of engineering constants, formulation of elasticity problems.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Two dimensional problems in Cartesian co-ordinates: Plane stress, plane strain, Airy's stress function, investigation of simple beam problems, bending of a narrow cantilever beam under end load, simply supported beam with uniformly distributed load.

Two dimensional problems in Polar co-ordinates: Basic relations in polar coordinates, Equilibrium equation and strain-displacement relations in polar coordinates, compatibility equation and biharmonic equation in polar coordinates, thick walled cylinder subjected to internal and external pressure, rotating disks of uniform thickness.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Torsion of Prismatic Bars: Introduction, Torsion of circular and elliptical cross section bars, Prandtl's Membrane analogy, Torsion of thin-walled sections.

Viscoelasticity: Linear viscoelastic behavior. Simple viscoelastic models-generalized models, linear differential operator equation.

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:

CO 1 Describe the concept of state of stress at a point and determine the components of stress on any given plane and principal stresses.
CO 2 Compute the state of strain in an arbitrary plane and principal strains and Co-relate the stress components with strain components using generalized Hooke's law.
CO 3 Analyze the two-dimensional problems in Cartesian co-ordinates by applying the concept of Airy's stress function and bi-harmonic equations.
CO 4 Analyze the stresses for two-dimensional problems on rotating disks in the polar coordinate system.
CO 5 Determine the shear flow and shear stress distribution in thin walled sections; Describe the generalized models used for modelling viscoelastic behavior.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Timoshenko and Goodier, "Theory of Elasticity", Third Edition, Tata McGraw Hill Book Company, 2010.
2. Dym C. L and Shames. I. H, "Solid Mechanics : A variational approach", Springer, 2013.
3. T.G.Sitharam, "Applied Elasticity", Interline publishing, 2008.
4. G. T. Mase, R.E. Smelser, R.M. Smelser, G.E. Mase, "Continuum Mechanics for Engineers", Taylor and Francis, 2009.
5. Sadhu Singh, "Theory of Plasticity and Metal forming Process", Khanna Publishers, Delhi, 1999

REFERENCE BOOKS

1. L S Srinath, "Advanced Mechanics of Solids", Third Edition, Tata McGraw Hill Company, 2009.
2. Sadhu Singh, "Theory of Elasticity", Khanna publishers, 2010..
3. Wang. C. T., "Applied Elasticity", McGraw Hill, 1953.
4. Haffman and Sachs, "Introduction to the Theory of Plasticity for Engineers", Literary Licensing, LLC, 2012.
5. Dill, Ellis Harold, "Continuum Mechanics: Elasticity, Plasticity, Viscoelasticity", CRC Press , 2006.

Web links and Video Lectures (e-Resources):

1. https://onlinecourses.nptel.ac.in/noc22_ce103/preview

Course Articulation Matrix :

Course Code / Name : 21MEE201/ ADVANCED STRENGTH OF MATERIALS															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	1	2		1	1		3	1		1	3	1	1
CO 2	2	3	1	2	1	1	1		3	1		1	3	1	1
CO 3	2	3	1	2	1	1	1		3	1		1	3	1	1
CO 4	2	3	1	2	1	1	1		3	1		1	3	1	1
CO 5	2	3	1	2	1	1	1		3	1		1	3	1	1
1: Low 2: Medium 3: High															

Material selection for Engineering Design			
Course Code:	21MEE202	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Understand design process and properties of engineering materials
2. Apply the knowledge of material selection using material property charts and to gain knowledge about material selection under fatigue, corrosion &fracture.
3. Understand wear mechanism and knowledge of the design of plastics and ceramics.
4. Apply process selection procedure and to gain the knowledge in process selection through case studies.
5. Understand design for machining and joining process and to know the basics of hybrids.

UNIT -1

The design process: types of design, design tools, conceptual and configuration design of products, analysis of technical systems, case study.

Families of engineering materials and mechanical properties: Ferrous and Non-ferrous metals and Alloys, Ceramics, Polymers, Composites. The causes of failure in service.

Effects of composition, structure and processing on material properties; Material property charts, Basis of material selection. Evolution of microstructure change in steel products.

Design for fracture toughness, fatigue resistance, corrosion resistance, and high temperature applications. Case studies in materials selection

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Design for Wear resistance, wear mechanism, and wear design; case studies for design with plastics, ceramics and composites.

Manufacturing aspects of design: Processes and process selection, selection charts, taxonomy of the process kingdom; case studies in process selection; case studies: design for casting, effect of casting on properties, design for deformation processes.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Designing for machining and joining, design for ceramic and plastic processing; case studies with multiple constraints and conflicting objective, Introduction to hybrids and types.

8 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:

CO 1 Understand the basics of design processes and mechanical properties of engineering materials.

CO 2 Analyze selection of materials using material property charts through case studies.

CO 3 Understand wear mechanisms and knowledge of design for plastics, composites and ceramics.

CO 4 Analyze the selection of processes using charts.
CO 5 Review the study of machining and joining processes and introduction to hybrid materials.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOK:

1. Material selection in Mechanical Design, Michael F. Ashby, Elsevier (3rd edition 2005).

REFERENCE BOOKS

1. Henry H. ASM Hand book of Materials Selection and Deign, 1996

Web links and Video Lectures (e-Resources):

Course Articulation Matrix :

Course Code / Name : 21MEE202/ MATERIAL SELECTION FOR ENGINEERING DESIGN															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1		1			1	2	2			1	1		3	1	
CO 2	2	1	2	1		2	2	2	2	2		1	2	2	
CO 3	2		2	2		2	1	1			1		3	2	
CO 4	1		1		1	2	2	2	1	2	1	2	1	2	
CO 5	2		1	2	1	2	2		1		1	2	2	1	
1: Low 2: Medium 3: High															

Design of Experiments			
Course Code:	21MEE203	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Explain Basic concept of experimental design and fundamentals of Statistics.
2. Discuss basic concepts of Experimental design.
3. Discuss Analysis of variance and regression analysis.
4. Discuss Experimental Design approaches of Robust Design and Taguchi's orthogonal arrays
5. Explain the concepts of Signal to Noise Ratio, parameter design and tolerance design.

UNIT -1

Introduction: Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments.

Basic Statistical Concepts: Concepts of random variable, probability, density function cumulative distribution function. Sample and population, Measure of Central tendency; Mean median and mode, Measures of Variability, Concept of confidence level. Statistical Distributions: Normal, Log Normal & Weibull distributions. Hypothesis testing, Probability plots, choice of sample size. Illustration through Numerical examples.

Experimental Design: Classical Experiments: Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs. Illustration through Numerical examples

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Analysis And Interpretation Methods: Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples.

Quality By Experimental Design: Quality, Western and Taguchi's quality philosophy, elements of cost, Noise factors causes of variation. Quadratic loss function & variations of quadratic loss function. Robust Design: Steps in Robust Design: Parameter design and Tolerance Design. Reliability Improvement through experiments, Illustration through Numerical examples.

Experiment Design Using Taguchi's Orthogonal Arrays: Types of Orthogonal Arrays, selection of standard orthogonal arrays, Linear graphs and Interaction assignment, Dummy level Technique, Compound factor method, Modification of linear graphs. Illustration through Numerical examples.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3	
Signal To Noise Ratio: Evaluation of sensitivity to noise. Signal to Noise ratios for static problems: Smaller-the-better type, Nominal-the –better-type, Larger-the-better type. Signal to Noise ratios for Dynamic problems. Illustration through Numerical examples. **Parameter And Tolerance Design:** Parameter and tolerance design concepts, Taguchi's inner and outer arrays, parameter design strategy, tolerance design strategy. Illustration through Numerical examples. 07 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:

CO 1 Explain Basic concept of experimental design and fundamentals of Statistics.

CO 2 Discuss basic concepts of Experimental design.

CO 3 Discuss Analysis of variance and regression analysis.

CO 4 Discuss Experimental Design approaches of Robust Design and Taguchi's orthogonal arrays

CO 5 Explain the concepts of Signal to Noise Ratio, parameter design and tolerance design.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Box GEP, Hunter JS, Hunter WG, 2005. Statistics for Experimenters. 2nd ed. Wiley.
2. Design and Analysis of Experiments, 8ed, ISV (WSE) Paperback – 2013by Douglas C. Montgomery

REFERENCE BOOKS

1. Statistical Quality Control: Montgomery, Douglas, 5th Edition, John Wiley & Sons, Inc. 2005, Hoboken, NJ (ISBN 0-471-65631-3).
2. Principles of Quality Control: Jerry Banks, Wiley & Sons, Inc. New York.
3. Total Quality Management: D.H. Besterfield et al., 2019, Pearson India Education Services Private Ltd.
4. Design and Analysis of Experiments: R. Pannerselvam, 2012, PHI Learning Private Limited, New Delhi

Web links and Video Lectures (e-Resources):

1. NPTEL course material related to operations management, TQM, operations research

Course Articulation Matrix :

Course Code / Name : 21MEE203/ DESIGN OF EXPERIMENTS															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	1									2				3
CO 2	2	2	1								2				3
CO 3	1	1	2							2	2				3
CO 4	3	2	2								3				3
CO 5	1	1	1								1				2
1: Low 2: Medium 3: High															

Mechanical Vibrations			
Course Code	21MEE205	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Understand about single degree of freedom systems, modelling and determination of its parameters.
2. Know about damping, types of damping and its influence on the system response.
3. Understand the response of mechanical systems subjected to harmonic excitation and about vibration measurement.
4. Understand about two degree of freedom systems, to find its natural frequencies and mode shapes.
5. Understand about multi degree freedom system problems.

UNIT -1	
Introduction: Types of Vibrations, Simple Harmonic Motion, and Principle of superposition applied to simple harmonic motions, Beats and simple problems. **Undamped Free Vibrations:** Single Degree of Freedom systems, Natural frequency of undamped free vibrations, Parallel and series combination of springs-equivalent stiffness, effect of mass of spring on natural frequency, Problems. **Damped Free Vibrations:** Single degree of freedom systems, Different types of damping, Concept of critical damping and its importance, Study of response of viscous damped systems for cases of under-damping, critical-damping and over-damping, Logarithmic Decrement, Problems. **15 Hours**	
Pedagogy	Chalk and talk, Power point presentation, Videos
UNIT -2	
Forced Vibrations: Single Degree of Freedom Systems, Forced Vibration of spring-mass-damper system, transient and steady state solution, Reciprocating and rotating unbalance, Force transmitted to the base due to harmonic excitation-Force Transmissibility, Vibrations due to support motion-Motion Transmissibility. **Vibration Measurement:** Vibrometers and Accelerometers, Numerical problems. **Analysis of two Degrees of Freedom Systems:** Introduction, principal modes of vibration, masses on tightly stretched strings, double pendulum, problems. **15 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT -3	
Numerical methods for multi degree freedom systems: Introduction, Influence coefficients, Maxwell's reciprocal theorem, Method of Matrix Iteration, Stodola's Method, and Holzer's method. **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:** **CO 1** Calculate the natural frequency of a single degree of freedom system using Newton's second law of motion and energy method and apply mathematical techniques to model systems. **CO 2** Distinguish between different types of mechanical systems depending on the amount of viscous damping present in the system and determine its characteristics. Determine parameters of underdamped systems using logarithmic decrement. **CO 3** Determine the response and characteristics of mechanical systems subjected to harmonic excitation using mathematical modeling. Discuss the use of vibration measurement using vibrometers and accelerometers. **CO 4** Calculate the natural frequencies and mode shapes of two degrees of freedom systems. Determine the amplitude of vibration using vibration measurement instruments. **CO 5** Calculate natural frequencies and mode shapes of multi degree freedom systems using Stodola, Matrix Iteration, and Holzer's method.	

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS

1. Mechanical Vibrations, S. S. Rao, Pearson Education Inc, 4PthP Edition, 2003.
2. Mechanical Vibrations, V. P. Singh, DhanpatRai & Company Pvt. Ltd., 3PrdP Edition, 2006.
3. Mechanical Vibrations, G. K. Groover, Nem Chand and Bros., Rookee, India, Seventh Edition, 2003.
4. Mechanical Vibrations, William Seto, Schaum's Outline Series, McGraw Hill, 1983

REFERENCE BOOKS

1. Mechanical Vibrations, S. Graham Kelly, Schaum's Outline Series, Tata McGraw Hill, Special Indian Edition, 2007.
2. Theory and Practice of Mechanical Vibrations, J. S. Rao and K. Gupta, New Age International Publications, New Delhi, 2001.
3. Elements of Vibration Analysis, Leonard Meirovitch, Tata McGraw Hill, Special Indian Edition, 2007.
4. Mechanical Vibrations, J. B. K. Das and Srinivasa Murthy, Sapna Book House, Fifth Edition, 2009.
5. Theory of Vibration with Applications, W. T. Thomson and Marie Dillon Dahleh, Pearson Education, 5PthP Edition, 2007.

Web links and Video Lectures (e-Resources):

1. http://nptel.ac.in/courses/112103111/
2. http://nptel.ac.in/courses/112103112/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-003sc-engineering-dynamics- fall-2011/mechanical-vibration/

Course Articulation Matrix :

Course Code / Name : 21MEE205 / MECHANICAL VIBRATIONS															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
CO 1	1	2	3	0	0	1	0	0	0	0	0	1	3	0	0
CO 2	1	3	1	0	0	1	0	0	0	0	0	1	3	0	0
CO 3	1	2	3	1	0	1	0	0	0	0	0	1	3	0	0
CO 4	1	2	3	0	0	1	0	0	0	0	0	1	3	0	0
CO 5	1	3	2	0	0	1	0	0	0	0	0	1	3	0	0
1: Low 2: Medium 3: High															

Design of Aircraft Structures			
Course Code:	21MEE206	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Discuss aircraft design process, loads and structures.
2. Discuss aircraft material properties, static and fatigue failures.
3. Explain and solve problems related to bars, beams, shafts and columns.
4. Explain and solve problems related to box beams and buckling of thin sheets.
5. Discuss and solve problems related to Structural Joints, Advanced materials, Vibrations and Flutter

UNIT -1

Overview of the Aircraft Design Process: Introduction, Phases of Aircraft Design, Aircraft Conceptual Design Process, Conceptual Stage, Preliminary Design, Detailed Design, Design Methodologies, Airworthiness- Definition, Airworthiness Regulations, Regulatory Bodies, Type certification, General Requirements, Requirements Related to Aircraft Design covers- Performance and Flight Requirements, Airframe Requirements, Landing Requirements, Fatigue and Failsafe requirements, Emergency Provisions, Emergency Landing requirements.

Aircraft Loads: Aerodynamic Loads, Inertial Loads, Loads due to engine, Actuator Loads, Maneuver Loads, VN diagrams, Gust Loads, Ground Loads, Ground conditions, Miscellaneous Loads.

Aircraft Structures Description: Types of Structural members of Fuselage and wing section and empennage Ribs, Spars, Frames, Stringers, Longeron, Splices, Types of structural joints, Type of Loads

on structural joints.

Aircraft Materials and properties: Introduction, Basic construction, Material forms-Metallic materials and forms. Alloy designations. Mechanical Properties- strength, static, stress strain curves, Fatigue properties, crack growth.

Static and Fatigue Failures: Principal stresses, principal strains, Mohr's circle for stress and strain, Fatigue Failures, Fatigue theory, Introduction to Low cycle Fatigue, Stress Life and Strain Life Techniques, Mean stress effects, Multi-axial Effects, Thermomechanical Fatigue, Introduction to high cycle fatigue.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Theory of bars ,Beams, Shafts and Columns: Axially loaded structures, Methods of analysis-Method of joints and Method of sections, Space truss.

Beam theory, Section properties, Deflection of beams, Symmetric and Unsymmetric bending, Plastic bending, Shear stress in beams, Shear center, Torsion of Solid Sections, Torsion of Thin walled-open and closed sections, Columns Theory-Euler equation, Effective column length, Plasticity effects, Thin walled columns-Crippling, Beam columns.

Box Beams: Box Beams- Introduction, Shear flow due to shear, Shear flow due to torsion-Bredt Baths, Single and Multicell Boxes

Buckling of Thin Sheets: Buckling of thin sheets, Buckling of flat plate in compression and shear, Buckling of curved plates in compression and shear, buckling of stiffened panels-post buckling, effective width, Concept of diagonal tension, buckling under combined loads.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Aircraft Structural Joints: Introduction, Fasteners, Splices, and Eccentric joints-Bolt Group Analysis, Welded joints, Bonded joints, Lug Analysis, Tension Fitting and clips

Advanced materials, Vibrations and Flutter: Introduction to Comp Materials, Matrices, Fibers, Forms, Characteristics of composite materials, Importance of Study of Vibration and Flutter.

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:

CO 1 Discuss aircraft design process, loads and structures.

CO 2 Discuss aircraft material properties, static and fatigue failures.

CO 3 Explain and solve problems related to bars, beams, shafts and columns.

CO 4 Explain and solve problems related to box beams and buckling of thin sheets.

CO 5 Discuss and solve problems related to Structural Joints, Advanced materials, Vibrations and Flutter.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Aircraft Design-A Conceptual Approach by Daniel P.Raymer, AIAA Education, series,6th Edition
2. Airframe Structural Design by Michael Niu, Conmilit Press, 1988,2nd Edition.

REFERENCE BOOKS

1. Airframe Stress Analysis and Sizing by Michael Niu, Conmilit Press, 1999,3rd Edition
2. Aircraft Structures for engineering students by T. H. G. Megson, Butterworth-Heinemann,Third Edition
3. The Elements of Aircraft Preliminary Design – Roger D. Schaufele, Aries Publications, 2000
4. An Introduction to Aircraft Certification; A Guide to Understanding JAA, EASA and FAA by Filippo De Florio, Butterworth-Heinemann

Web links and Video Lectures (e-Resources):

1. http://www.aero.org/
2. http://www.rl.af.mil/rrs/resources/griffiss_aeroclub/aircraft.html
3. http://ameslib.arc.nasa.gov/randt/1999/aero/aero.html
4. http://www.ctas.arc.nasa.gov/project_description/pas.html
5. http://www.moog.com/noq/_acoverview__c463/
6. http://www.dcmt.cranfield.ac.uk/aeroxtra/e339.htm
7. http://www.aeromech.usyd.edu.au/structures/as/acs1-p4.htm
8. http://www.av8n.com/how/htm/xref.html

Course Articulation Matrix :

Course Code / Name : 21MEE206/ DESIGN OF AIRCRAFT STRUCTURES															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	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	PSO 3
CO 1	2	2	3								2			1	
CO 2	3	2	2								2			1	
CO 3	1	2	3								2			2	
CO 4	2	3	2								2			2	
CO 5	2	2	3			1	2	1			2			2	
1: Low 2: Medium 3: High															

Computational Fluid Dynamics			
Course Code:	21MEE209	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Understand the basic concepts of computational dynamics and a brief solution procedure
2. Derive the equations related to turbulent flows and understand various discretization methods
3. Understand the solution obtained by CFD.
4. Know the areas where CFD is applicable.
5. Know the application of CFD to multiphase systems and fluid structure interaction.

UNIT -1

INTRODUCTION: Computational Fluid Dynamics, Advantages, Applications, Future of CFD. CFD
SOLUTION PROCEDURE: Problem set up-pre-process, Numerical solution – CFD solver, Result report and visualization-post-process.
EQUATIONS FOR CFD: Introduction, the continuity equation, the momentum equation, the energy equation, the additional equations for turbulent flows, generic form of the governing equations for CFD, boundary conditions.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2	
CFD TECHNIQUES: Introduction, Discretization of governing equations, Finite difference method, Finite volume method, converting governing equations to algebraic equation system, Numerical solutions. **CFD SOLUTION ANALYSIS:** Introduction, consistency, stability, convergence, accuracy, efficiency, case studies. **PRACTICAL GUIDELINES FOR CFD:** Introduction, grid generation, boundary conditions, turbulent modeling **14 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT - 3	
APPLICATIONS OF CFD: Introduction, CFD as a design tool, indoor air flow distribution, CFD as a research tool, CFD applied to heat transfer coupled with fluid flow, buoyant free standing fire, flow over vehicle platoon, air/particle flow in human nasal cavity, high speed flows. **ADVANCED TOPICS IN CFD**: Introduction, advances in numerical methods and techniques – incompressible flows, compressible flows, moving grids, multigrid methods, parallel computing, immersed boundary methods. Advances in computational methods – DNS, LES, RANS-LES coupling for turbulent flows, multiphase flows, combustion, fluid structure interaction, physiological fluid dynamics and other numerical approaches. **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:** **CO 1** Explain the Basic theory of computational fluid dynamics. Discuss the equations of CFD and application of CFD in industrial application. **CO 2** Determine the optimized parameters to achieve stability, convergence, accuracy and efficiency of mechanical systems. **CO 3** Identify and solve convergence and non-convergence problems. **CO 4** Explain the working principle of CFD algorithm and discuss its applications. **CO 5** Explain the concept of RANS,DNS,LES. Discuss simplex and semi implicit CFD programming methods	

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Computational Fluid Dynamic – a practical approach, Jiyuan Tu, Guan Heng Yeoh and Chaoqun Liu, Butterworth-Heinemann (ELSEVIER), 2008
2. An introduction to CFD, H. Versteeg and W. Malalasekra, Pearson, Education, 2 nd Edition, 2008.

Web links and Video Lectures (e-Resources):

1. http://www.nptelvideos.in/2012/11/mathematics-iii.html

Course Articulation Matrix :

Course Code / Name : 21MEE209/ COMPUTATIONAL FLUID DYNAMICS															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	1	1					1	1				3	2	3
CO 2	1	3	2					1	1				3	2	1
CO 3	3	2	3		1			1	1				3	2	3
CO 4	3	1	1					1	1				3	2	3
CO 5	3	1	1		1			1	1				1	2	3
1: Low 2: Medium 3: High															

Internal Combustion Engines			
Course Code:	21MEE210	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Identify the thermal sciences related to IC engine; know combustion processes involved in S.I Engine and different variables affecting it.
2. Demonstrate combustion process in C. I Engine and different variables affecting it also how methods of swirl generation lead to better combustion.
3. Distinguish the various emissions from SI & CI engine and highlight the various control techniques used.
4. Illustrate engine modification for the use of alternate fuels like LPG, Hydrogen & alcohol.
5. Summarize the recent developments in engines and Measurement of different engine parameters.

UNIT -1

SPARK IGNITION ENGINES: Spark ignition Engine mixture requirements - Feedback Control Carburettors -Fuel - Injection systems - Monopoint and Multipoint injection System- Stages of combustion - Normal and Abnormal Combustion-Factors affecting knock - Combustion Chambers -.

COMPRESSION IGNITION ENGINES: Stages of combustion in C.I. Engine - Direct and indirect injection systems -Combustion chambers.

Spray characteristics - Fuel spray behavior - spray structure, spray penetration and evaporation - Air motion – Turbocharging.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

POLLUTANT FORMATION & CONTROL: Pollutant - Sources and types - formation of NOx - Hydrocarbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions – Mechanism of sooth and smoke formation.

Pollutant Control - Methods of controlling Emissions- Catalytic converters and Particulate Traps- Methods of measurements and Driving cycles. Evolution and implementation of Bharath Stage norms.

ALTERNATIVE FUELS: Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas, Bio-diesel. Properties, Suitability, Engine Modifications, Merits and Demerits as fuels.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

RECENT TRENDS: Lean Burn Engines - Stratified Charge Engines - Gasoline Direct Injection Engine - Homogeneous Charge Compression Ignition, Fuel Cells - working, properties, merits and demerits. Introduction to Electric drives and Hybrids. Measurement techniques: Bosch Smoke meter, Hartridge smoke meter, Measurement of Brake Power by dynamometers. Future of IC Engines

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:

CO 1 Describe stages of the combustion processes involved in SI Engine and variables affecting it.

CO 2 Describe stages of the combustion processes involved in CI Engine and variables affecting it.

CO 3 Identify different types of emissions from SI & CI engines and explain techniques to solve air pollution problems.

CO 4 Explain the methods of production of alternative fuels for IC engines. Describe engine modification techniques used in IC engines for alternate fuels.

CO 5 Explain the recent trends in IC engines, SCI, HCCI, electric drives and fuel cells.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

REFERENCE BOOKS

1. John B. Heywood, “Internal Combustion Engine Fundamentals ", McGraw Hill, 1988.
2. Charles Fayette Taylor ‘The Internal-combustion Engine in Theory and Practice, MIT PRESS Massachusetts Institute of Technology
3. M.L Mathur and R.P.Sharma, " Internal Combustion Engine".
4. Rowland S.Benson and N.D.Whitehouse, " Internal combustion Engines ", Vol.I and II,

Pergamon Press, 1983.
5. Duffy Smith, "Auto fuel Systems ", the Good Heart Willox Company, Inc., 1987.
6. Ryan O Hayre, Suk – Woncha, Whitney colella, Fritz B.Prinz, "Fuel Cell Fundamentals", Second Edition, John Wiley Publication,2009.

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses

Course Articulation Matrix :

Course Code / Name : 21MEE210 / INTERNAL COMBUSTION ENGINES															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	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	PSO 3
CO 1	3	2				1	1		1			1	3	1	
CO 2	3	2				1	1		1			1	3	1	
CO 3	2	2				1	1		1			1	3	1	
CO 4	2	2				1	1		1			1	3	1	
CO 5	3	2				1	1		1			1	3	1	
1: Low 2: Medium 3: High															

Gas Propulsion and Aerodynamics

Course Code:	21MEE211	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Present gas and aerospace propulsive devices as systems, with functional requirements
2. Demonstrate engineering and environmental limitations along with requirements and limitations that constrain design choices.
3. Present mission analysis, fundamental performance relations, and exemplary design solutions
4. Impart knowledge on compressible flow through ducts,
5. Impart knowledge on jet propulsion and space propulsion.

UNIT -1

BASIC CONCEPTS AND ISENTROPIC FLOWS: Energy and momentum equations of compressible fluid flows - Stagnation states, Mach waves and Mach cone –Effect of Mach number on compressibility - Isentropic flow through variable area ducts - Nozzle and Diffusers –Use of Gas tables.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation, Case studies

UNIT -2	
THEORY OF JET & SPACE PROPULSION: Thrust equation - Thrust power and propulsive efficiency - Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines – Aircraft combustors. Types of rocket engines - Propellants - Ignition and combustion - Theory of rocket propulsion – Performance study - Staging - Terminal and characteristic velocity - Applications - Space flights. **14 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation, Case studies
UNIT - 3	
Introduction to Aerodynamics: Atmosphere (lSA) and its stability Continuum hypothesis, dynamic similarity, Aero foil nomenclature, forces and moments Incompressible irrotational flow, Complex potential, Singularities and superposition, Blasius theorem, Method of images Circulation, Robins Magnus effect and Kutta .Joukowski theorem Conformal Mapping and Joukowski air foil. **9 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation, Case studies and demos

Course outcome (Course Skill Set)

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

CO 1 To design and develop efficient and economical propulsion systems

CO 2 To describe Effect of Mach number on compressibility

CO 3 Carry out preliminary designs of rocket or air breathing propulsion systems to meet specified requirements.

CO 4 To illustrate issues with jet crossing higher Mach numbers

CO 5 To assess the stability Continuum hypothesis, dynamic similarity

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS

1. The dynamics and thermodynamics of compressible flows: A. H Shapiro, John Wiley and Sons.
2. Hill P and Peterson C, " Mechanics and Thermodynamics of Propulsion ", Addison Wesley Publishing Company, 1992.
3. Ganesan V, Gas Turbines, Tata McGraw-Hill Publishing Company Ltd., 2003.
4. Yahya S M " Fundamentals of Compressible Flow ", New Age International (P) Limited, New Delhi, 1996.

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/101/101/101101002/
2. https://www.iitk.ac.in/aero/courses
3. https://ocw.mit.edu/courses/16-50-introduction-to-propulsion-systems-spring-2012/pages/syllabus/

Course Articulation Matrix :

Course Code / Name : 21MEE211 / GAS PROPULSION AND AERODYNAMICS															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	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	PSO 3
CO 1	1				1					1					1
CO 2	2				1					2					2
CO 3	2				1					2					2
CO 4	2				1					2					2
CO 5	2				1					2					2
1: Low 2: Medium 3: High															

Non Traditional Machining			
Course Code:	21MEE212	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. To understand about non-traditional machining process, its need and importance in manufacturing.
2. To know how to machine hard and tough materials by using thermo-electric energy like plasma, laser and electron beam.
3. To understand how to machine brittle and soft materials by applying mechanical energy using

abrasives in combination of ultrasonic energy or pressurized fluids like gas and liquids.
4. To know how to fabricate tools and dies which are made-up of hard materials using electric discharge energy.
5. Get an idea of how electro-chemical & chemical energy is used to machine hard, tough and brittle materials with high metal removal rate.

UNIT -1

INTRODUCTION: Introduction, Classification, Comparison with traditional machining, Need of NTM, Process selection and applications.

PLASMA ARC MACHINING (PAM): Introduction, Plasma generation, Machining Principle, Mechanism of Metal Removal Rate, Parameters, Plasma torch- Mode of operation, types and design of torch, Selection of gas, Process Characteristics, Working Environment & Safety precautions, Applications, Advantages & Limitations.

LASER BEAM MACHINING (LBM): Introduction, Laser Generation- Solid state pulse laser and CO2 gas laser, Equipments, Machining Principle, Process Characteristics, Applications, Advantages & Limitations.

ELECTRON BEAM MACHINING (EBM): Introduction, Machining Principle & Equipment's, Process Characteristics, Application, Advantages & Limitations.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

ELECTROCHEMICAL MACHINING (ECM): Introduction, Machine setup, Electrolyte and its system, Process Characteristics, Process Capability, Types of tools, Tool and Insulation materials, Tool size, Handling of Slug, Applications- Cavity Sinking, Drilling & Trepanning, Electro-Chemical turning, Electro-Chemical Sawing & Cutting, Electro- Chemical honing, Electro-Chemical Deburring and Electro-Chemical Grinding, Economics of ECM, Advantages & Limitations.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

ELECTRICAL DISCHARGE MACHINING (EDM): Introduction, Machine setup, Dielectric Fluid, Generators, Electrode feed control, Tools used, Flushing, Process Characteristics, Applications, Electric Discharge Grinding, Wire EDM, Advantages & Limitations.

CHEMICAL MACHINING (CHM): Introduction, CHM Technique, Classification, Maskant. Chemical Blanking: Process steps, Process Characteristics, Applications, Advantages & Limitations. Chemical Milling: Process steps, Process Characteristics, Applications, Advantages & Limitations.

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:

CO 1 Apply the engineering knowledge and analyze to get solutions to the machining problem.

CO 2 Conduct investigation on the machining problem and use modern tools in machining for the benefit of society.

CO 3 Understand the machine cutting technology on environment and use the technology with ethics

responsibly.

CO 4 Apply the process individually and also as team with efficient communication between them.

CO 5 Manage & use the process efficiently and also financially and also provides the opportUNIT y to improvement.

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:

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:

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 full questions carrying equal marks.
2. Each full question will be for 20 marks.
3. There will be two full questions (with a maximum of four sub- questions) from each module.
4. Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

REFERENCE BOOKS

iii) Modern machining process, Pandey and Shah, Tata McGraw Hill 2000.

iv) Production Technology: HMT Tata McGraw Hill 2001.

v) Non-Conventional Machining, P.K. Mishra, The Institution of Engineers (India) Test book series, Narosa Publishing House 2005.

vi) Metals Handbook: Machining- Volume 16.

vii) Nontraditional Machining Processes, E. Weller, Society of Manufacturing, 2 Sub edition (1984).

Web links and Video Lectures (e-Resources):

1. https://link.springer.com/book/10.1007/978-1-4471-5179-1.
2. https://www.goodreads.com/book/show/38725935-non-traditional-machining-processes.
3. https://archive.nptel.ac.in/courses/112/105/112105212.

Course Articulation Matrix :

Course Code / Name : 21MEE212 / NON TRADITIONAL MACHINING															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	2	1			2	2	2	3	3	1	3
CO 2	3	3	3	3	3	3	2	1	2	2	1	2	2	1	3
CO 3	3	3	3	3	3	3	2	3	1	2	3	2	3	1	3
CO 4	3	3	3	2	2	1			2	2	2	3	3	2	3
CO 5	3	3	3	3	3	3	2	1	2	2	1	2	2	1	3
1: Low 2: Medium 3: High															

Automation in Manufacturing			
Course Code:	21MEE213	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. To understand the concepts of automation in manufacturing systems
2. To impart the knowledge of a line balancing and assembly systems
3. To explore the idea of robotics and understand the computerized manufacturing planning
4. To gain the knowledge of automated inspection and shop floor control
5. To understand the concepts of additive manufacturing and latest trends in manufacturing

UNIT -1

Introduction: Production system facilities, Manufacturing support systems, Automation in production systems, Automation principles &strategies

Manufacturing operations: Manufacturing operations, Product/production relationship, Production concepts and Mathematical models & costs of manufacturing operations. Problems on mathematical models.

Line Balancing: Methods of line balancing, Numerical problems on largest candidate rule, Kilbridge's and Wester's method, and ranked positional weights method, computerized line balancing methods.

Automated assembly systems : Design for automated assembly, types of automated assembly system, Parts feeding devices, Analysis of single and multi-station assembly machines.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Computerized Manufacture Planning and AGVS: Computer aided process planning (CAPP), Retrieval and Generative systems, and benefits of CAPP. Material requirement planning, Inputs to MRP system, working of MRP, Outputs and benefits. Automated Guided Vehicles System: Applications, Guidance, and routing,

Industrial Robotics: Definition, Robot anatomy, Joints and links, Robot configurations, Robot control systems, Accuracy and repeatability, End effectors, Sensors in robotics. Industrial robot applications: Material handling, Processing, assembly, and inspection.

Inspection Technologies: Automated inspection, coordinate measuring machines construction, Operation & programming, Software, application &benefits, Flexible inspection system, Inspection probes on machine tools, Machine vision, Optical inspection techniques & non-contact non-optical inspection technologies.

14 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Shop Floor Control and Automatic Identification Techniques: Shop floor control, Factory data collection system, Automatic identification methods, Bar code technology, Automatic data collection systems. An Introduction to QR Code Technology

Additive Manufacturing Systems: Basic principles of additive manufacturing, Slicing CAD models for AM, Advantages and limitations of AM technologies, Recent trends in manufacturing, Hybrid manufacturing.

Future of Automated Factory: Trends in manufacturing, the future automated factory, Human workers in future automated factory, social impact. **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:

CO 1 Explain the basics of productions, automation system and manufacturing operations. Solve the simple problems on mathematical model.

CO 2 Analyze and solve problems online balancing

CO 3 Explain CAPP and MRP system and analyze the AGVS

CO 4 Understand the inspection technologies and shop floor control

CO 5 Explain the modern trends in additive manufacturing and automated factory

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Mikell P Groover, Automation, Production Systems and Computer-Integrated Manufacturing, PHI Learning, 3rd Edition, 2009.
2. P N Rao, CAD / CAM Principles and Applications, Tata McGraw-Hill, 3rd Edition, 2015
3. Ian Gibson, David W. Rosen, BrentStucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2nd Ed. (2015).

REFERENCE BOOKS

1. Dr.Nanua Singh, Systems Approach to Computer Integrated Design & Manufacturing, Wiley, 1996.
2. P. Radhakrishnan, S. Subramanyan, U.Raju, CAD/CAM/CIM, Revised Third Edition 2007

Web links and Video Lectures (e-Resources):

Course Articulation Matrix :

Course Code / Name : 21MEE213/ AUTOMATION IN MANUFACTURING															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	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	PSO 3
CO 1	3	3	2	2	2							2	2		2
CO 2	3	3	2	2	2							2	2		2
CO 3	3	3	2	2	2							2	2		2
CO 4	3	3	2	2	2							2	2		2
CO 5	3	3	2	2	2							2	2		2
1: Low 2: Medium 3: High															

Foundry Technology			
Course Code:	21MEE214	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. To Understand the different metallurgical aspects of consideration during casting design
2. Review the fundamentals of solidification and understand the different melting technologies.
3. Analyze the design concepts in gating systems in foundry and understand the special molding techniques used in foundry.
4. Understand the casting properties of important ferrous/ nonferrous materials and identify the difficulties in casting these alloys.
5. Identify the need for modernization and mechanization of foundries.

UNIT -1

Foundry Metallurgy: Oxidation of liquid metals, gas dissolution in liquid metals, methods of degassing, fluidity, factors affecting fluidity, fluidity tests, hot tearing, shrinkage of liquid metals. Casting design: Introduction to casting design, redesign considerations, design for minimum casting stresses, design for directional solidification, design for metal flow, safety factors, design for low pattern cost.

Solidification of castings: Crystallization and development of cast structure - nucleation, growth and dendritic growth. Coring and segregation. Concept of progressive and directional solidification, Solidification time and Chvorinov's rule. Structure of castings - refinement and modification of cast structure

Melting Furnaces: Introduction to various types of furnaces. Developments in cupola melting – hot blast cupola, water cooled cupola, balanced blast cupola, cokeless cupola, cupola charge calculations.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2	
Risering and Gating: Need for risering, general considerations of risering, riser types, riser size and location. Requirements of a riser. Sand, insulating, and exothermic materials used for risers. Riser feeding distance and theory of risering. Riser efficiency, methods to improve riser efficiency. Gating system – Classification, theoretical consideration of gating, laws of fluid flow, turbulence in gating system, need for tapered sprue, gating ratio(simple problems). Special Moulding Techniques: Principles, materials used, process details and application of no-bake sand systems, vacuum moulding, flaskless moulding, and high pressure moulding. **Ferrous Foundry:** Melting procedures, casting characteristics, production, specification, and properties of some typical steels, grey cast iron, malleable iron, and spheroidal graphite cast iron castings. **Non-Ferrous Foundry:** Melting procedures, casting characteristics, production, specification, and properties of some typical aluminum, copper, and magnesium-based alloy castings. 16 Hours	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT - 3	
Modernization and mechanization of foundry: Need for modernization, and mechanization, moulding and core making, melting, pouring, shake out equipment and fettling, dust and fume control, material handling equipments for sand moulds and cores, molten metal and castings, reclamation of sands. Pollution control. 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:** **CO 1** Identify the possible defects in the casting and suggest measures to reduce it. Suggest a Design to produce a casting in line with the thermal stress, metal flow, safety and economic aspects. **CO 2** Describe solidification phenomenon in castings and suggest suitable melting processes to melt ferrous and nonferrous material. Calculate the cupola charge to meet the required specification of casting **CO 3** Illustrate necessary gating criterions to produce fault free molding and select advanced molding techniques for producing high quality castings aiming at meeting the newer requirements such as higher productivity, mold finishing and faster production rate. **CO 4** Distinguish between metallurgical and production aspects of ferrous and nonferrous foundries and indicate necessary changes to be made in the manufacturing technique. **CO 5** Identify the needs for mechanization of foundry industries and analyse the impact of conventional foundry on human health and safety as per regulations.	

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:

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:

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

5. The question paper will have ten full questions carrying equal marks.
6. Each full question will be for 20 marks.
7. There will be two full questions (with a maximum of four sub- questions) from each module.
8. Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Principles of metal casting, Heine Loper & Rosenthal TMH – 2005
2. Principle of Foundry Technology, P. L. Jain, TMH – 2006.

REFERENCE BOOKS

1. Castings, John Campbell, Second edition, Elseivier, 2004
2. Foundry Technology, P. N. Rao, 2009
3. Manufacturing Process, I, Dr. K. Radha Krishna 5PthP Edn. Sapna Book House, Bangalore, 2009
4. Foundry Technology, O.P.Khanna. Dhanpat Rai Publications. 2011

Web links and Video Lectures (e-Resources):

1. NOC:Principles of Casting Technology, IIT Roorkee, Dr. Pradeep K. Jha

Course Articulation Matrix :

Course Code / Name : 21MEE214 / FOUNDRY TECHNOLOGY															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	1	0	0	0	0	0	0	0	0	0	0	1	1	3
CO 2	3	3	2	0	0	0	0	0	0	0	0	0	0	0	3
CO 3	3	2	2	0	0	0	0	0	0	0	0	0	1	0	3
CO 4	3	1	1	0	0	0	0	0	0	0	0	0	0	0	3
CO 5	3	1	3	0	0	1	0	0	0	0	0	0	0	1	3
1: Low 2: Medium 3: High															

Composite Materials Technology			
Course Code:	21MEE215	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
2. Apply Non-conventional composites materials depends on application and determine stresses and strains relation in composites materials.
3. Apply constitutive equations of composite materials and understand mechanical behavior at micro level.
4. Describe fundamental fabrication processes for polymer matrix, metal matrix, and ceramic matrix composites.
5. Use the ideas developed in the analysis of composites towards using composites in Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment .

UNIT -1

Introduction to Composite Materials: Definition, classification & brief history of composite materials.
Constituent of composite materials: Reinforcements, Matrix, Coupling agents, coatings & fillers.
Reinforcements: Introduction, Glass Fibers, Boron Fibers, Carbon Fibers, Organic Fibers, Ceramic Fibers, Whiskers, Other Non-oxide Reinforcements, Comparison of Fibers
Matrix Materials: Polymers, Metals and Ceramic Matrix Materials.
Interfaces: Wettability, Crystallographic nature of interface, types of bonding at the interface and optimum interfacial bond strength.
Polymer Matrix Composites (PMC): Processing of PMC's; Processing of Thermoset Matrix Composites, Thermoplastic Matrix Composites, Sheet Moulding Compound and carbon reinforced polymer composites. Interfaces in PMC's, Structure & Properties of PMC's,
Applications Metal Matrix Composites: Types of metal matrix composites, Important Metallic Matrices, Processing, Interfaces in Metal Matrix Composites, Properties & Applications.

14 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Nonconventional Composites: Introduction, Nanocomposites; Polymer clay nanocomposites, self healing composites, self-reinforced composites. Biocomposites, Laminates; Ceramic Laminates, Hybrid Composites.
Performance/Characterization of Composites: Static Mechanical Properties; Tensile Properties, Compressive Properties, Flexural Properties, In-Plane Shear Properties, Interlaminar Shear Strength.
Fatigue Properties; Tension-Tension Fatigue, Flexural Fatigue.
Impact Properties; Charpy, Izod, and Drop-Weight Impact Test.
Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli, Rule of mixture, Numerical problems.

14 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Manufacturing: Layup and curing - open and closed mould processing, Hand lay up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding

Application Developments: Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment

11 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:

CO 1 Use different types of manufacturing processes in the preparation of composite materials

CO 2 Identify the use of Non-conventional composites materials.

CO 3 Determine stresses and strains relation in composites materials.

CO 4 Derive four elastic moduli of the composite lamina to solve numerical problems associated with micro lamina.

CO 5 Explain different techniques for manufacturing and fabrication of composite materials and Explain application of composite material in engineering sectors.

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:

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:

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

9. The question paper will have ten full questions carrying equal marks.
10. Each full question will be for 20 marks.
11. There will be two full questions (with a maximum of four sub- questions) from each module.
12. Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Composite Material Science and Engineering Krishan K. Chawla Springer Third Edition First Indian Reprint 2015
2. Analysis and Performance of Fiber Composites, by Agarwal, McGraw Hill.
3. Mechanics of composite materials, Autar K. Kaw CRC Press New York.

REFERENCE BOOKS

1. Mechanics of Composite Materials & Structures Madhijit Mukhopadhay Universities Press 2004
2. Fibre-Reinforced Composites, Materials, Manufacturing, and Design P.K. Mallick CRC Press, Taylor & Francis Group Third Edition

Web links and Video Lectures (e-Resources):

Course Articulation Matrix :

Course Code / Name : 21MEE215/ COMPOSITE MATERIALS TECHNOLOGY															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	1	1	1	1	1					2	2		2
CO 2	2	2	1	1	1	1	1					2	2		2
CO 3	2	2	2	3	2	1	1					2	2		2
CO 4	2	2	2	2	2	1	1					2	2		2
CO 5	2	2	2	2	1	1	1					2	2		2
1: Low 2: Medium 3: High															

Non Destructive Testing

Course Code	21MEE216	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Outline the benefits obtained from NDT and describe the principles of Liquid Penetrant Inspection, Magnetic Particle Inspection.
2. Describe the principles of Eddy Current Inspection, Computed Tomography and Thermal inspection.
3. Explain Ultrasonic Inspection with major variables in ultrasonic inspection and summarize various ultrasonic waves.
4. Describe the principles of Radiographic Inspection, Electron radiography, Neutron radiography, Xeroradiography and summarize application of radiographic inspection in industry.
5. Explain the principles Acoustic Emission Inspection and summarize the AE sensors and preamplifiers, instrumentation principles, applications of AEI.

UNIT -1	
Introduction to Non-Destructive Testing: Selection of NDT methods, Various distinct areas of NDT, Visual Inspection: equipment's used for visual inspection and applications, Leak testing – brief introduction, Liquid Penetrant Inspection – principle, advantages, limitations and applications, Magnetic Particle Inspection – methods of generating magnetic fields, types of magnetic particles, suspending liquids, steps in inspection, advantages, limitations, and applications. **Eddy Current Inspection:** Principle, operation, operating variables, procedure, inspection coils, detectable discontinuities, advantages, and limitations and applications of E.C.I. **Thermal inspection:** Introduction, principles, Thermal inspection methods, equipment's, techniques, and applications. **15 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT -2	
Ultrasonic Inspection – Basic equipment, advantages, limitations, applications, characteristics of ultrasonic waves, major variables in ultrasonic inspection, basic inspection methods – pulse echo, transmission, transducer elements, couplants, search UNIT s, inspection standards. **Radiographic Inspection** – Principles, limitations, radiation sources – X rays, γ rays, recording media, film types and selection, interpretation of radiographs, image quality, penetrometers. **15 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT -3	
Acoustic Emission Inspection – principle, comparison of AE with other inspection methods, applications, AE waves and propagation, AE sensors and preamplifiers, instrumentation principles, applications. Multy-channel acoustic emission system, Use of AE Inspection in Production Quality Control and Metal Pressure Vessels and Storage Tanks, AEI applications research activities. **09 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation
Course outcome (Course Skill Set) **At the end of the course student will be able to** **CO 1** Describe the benefits of NDT over conventional methods. Illustrate the principles of Liquid Penetrant Inspection and Magnetic Particle Inspection to detect the cracks in steels **CO 2** Describe the principles of Eddy Current Inspection and Thermal inspection understanding its various applications **CO 3** Illustrate the principle of Ultrasonic Inspection technique, set-up and operation. Demonstrate the benefits of UT over other techniques for a given sample **CO 4** Illustrate the principles of Radiographic Inspection, and their applications. Interpet the radiography results of a given film of samples. **CO 5** Describe the principles of Acoustic Emission Inspection and analyse benefits and 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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS

1. NDE and Quality Control, Vo.17, ASM Hand book, 9th Edition, 1989

REFERENCE BOOKS

1. Practical Non-Destructive Testing, Baldev Raj, T.Jayakumar, M.Thavasimuthu, Narosa Publishers.
2. Non Destructive Test and Evaluation of Materials, J.Prasad and C G K Nair, Tata McGraw Hill.

Web links and Video Lectures (e-Resources):

1. https://www.nde-ed.org
2. https://www.youtube.com/channel/UCu4t0F_NiCcmfgRXZuHmW9Q/videos

Course Articulation Matrix :

Course Code / Name : 21MEE216 / NON-DESTRUCTIVE TESTING															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	1							1	1		1			3
CO 2	3	1							1	1		1			3
CO 3	2	3							1	1		1			3
CO 4	3	1							1	1		1			3
CO 5	3	1							1	1		1			3
1: Low 2: Medium 3: High															

Supply Chain and Logistic Management

Course Code:	21MEE217	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Know the significance of supply chain management, its drivers, how to build a strategic framework and designing the supply chain network.
2. Know about the models of facility location and evaluation of network design.
3. Understand the requirements of planning and managing inventories in a supply chain and sourcing and selecting suppliers.
4. Ascertain the role of information technology in supply chain management.
5. Know about logistics management and some of the emerging trends in supply chain and logistics management.

UNIT -1

BUILDING A STRATEGIC FRAME WORK TO ANALYSE SUPPLY CHAINS: Supply chain stages and decision phase, process view of a supply chain. Supply chain flows. Examples of supply chains. Competitive and supply chain strategies. Achieving strategic fit. Expanding strategic scope. Drivers of supply chain performance. Framework for structuring drivers – Inventory, Transportation, Facilities, Information. Obstacles to achieving fit, Case discussions.

DESIGNING THE SUPPLY CHAIN NETWORK: Distribution Networking – Role, Design. Supply Chain Network (SCN) – Role, Factors, Framework for Design Decisions.

FACILITY LOCATION AND NETWORK DESIGN: Models for facility location and capacity allocation. Impact of uncertainty on SCN – discounted cash flow analysis, evaluating network design decisions using decision trees. Analytical problems

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

PLANNING AND MANAGING INVENTORIES IN A SUPPLY CHAIN: Review of inventory concepts. Trade promotions, Managing multi- echelon cycle inventory, safety inventory determination. Impact of supply uncertainty aggregation and replenishment policies on safety inventory. Optimum level of product availability; importance factors. Managerial levers to improve supply chain profitability.

SOURCING, TRANSPORTATION AND PRICING PRODUCTS: Role of sourcing, supplier – scoring & assessment, selection and contracts. Design collaboration.

COORDINATION AND TECHNOLOGY IN THE SUPPLY CHAIN: Co-ordination in a supply chain: Bullwhip effect. Obstacles to coordination. Managerial levers to achieve co-ordination, Building strategic partnerships, The role of IT supply Chain, The Supply Chain IT framework, CRM, Internal SCM, SRM. The role of e-business in a supply chain, The e-business framework, e-business in practice. Case discussion.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

LOGISTICS MANAGEMENT: introduction, definition, systems approach, key logistics activities, developing logistics strategy, logistics information systems, transportation, warehousing, Global logistics.

EMERGING CONCEPTS: Reverse Logistics, Reasons, Activities, Role. RFID Systems; Components, applications, implementation. Lean supply chains, Implementation of Six Sigma in Supply Chains

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:

CO 1 Explain the significance of supply chain management, its drivers, how to build a strategic framework and designing the supply chain network.

CO 2 Discuss about designing the supply chain network.

CO 3 Explain about the requirements of planning and managing inventories in a supply chain and sourcing and selecting suppliers.

CO 4 Elaborate the role of coordination and technology in supply chain.

CO 5 Explain the need, significance and the latest concepts in logistics and supply chain management.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Supply Chain Management – Strategy, Planning & Operation - Sunil Chopra & Peter Meindl - Pearson Education Asia - ISBN: 81-7808-272- 1. – 2001.
2. Fundamentals of Logistics management – Douglas M.Lambert, James R.Stock & Lisa M. Ellram, Irwin McGraw-Hill, 2000.

REFERENCE BOOKS

1. Supply Chain Redesign – Transforming Supply Chains into Integrated Value Systems - Robert B Handfield, Ernest L Nichols, Jr. - Pearson Education Inc - ISBN: 81-297-0113-8. - 2002.
2. Modelling the Supply Chain -Jeremy F Shapiro, Duxbury - Thomson Learning – ISBN 0-534-37363. -2002.

3. Designing & Managing the Supply Chain -David Simchi Levi, Philip Kaminsky & Edith Simchi Levi - Mc Graw Hill.
4. Supply Chain and Logistics Management – Upendra Kachuru

Web links and Video Lectures (e-Resources):

Course Articulation Matrix :

Course Code / Name : 21MEE217 / SUPPLY CHAIN AND LOGISTIC MANAGEMENT															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	1				1	1				1				1
CO 2	3	1				1	1				1				1
CO 3	3	1				1	1				1				1
CO 4	3	1				1	1				1				1
CO 5	3	1				1	1				1				1

1: Low 2: Medium 3: High

Organizational Behavior

Course Code:	21MEE218	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Describe the Nature and Characteristics, Determinants and Approaches of Organizational Behaviour. Describe the concepts of Perception, Attitudes and values and their implications.
2. Describe the concepts of learning and motivation along with their managerial implications.
3. Describe the concepts of Leadership along with their managerial implications.
4. Discuss the concepts of group dynamics and conflict management along with their implications.
5. Discuss the concepts of Organization culture and change and conflict management along with their implications.

UNIT -1

Introduction- Conceptual Foundation of Organisational Behaviour; Nature and Characteristics; Determinants; Contributing Disciplines; Challenges and OpportUNIT ies for Organisational Behaviour, Models and Approaches of Organizational Behaviour, OB and Emotional Intelligence.

Perception, Attitude, and Values: Nature, Process, Importance, Factors Influencing Perception; Attribution Theory of Perception; Issues Involved in Perception: Selective Perception, Halo Effect, Contrast Effect, Projection, Stereotyping; Concept of Pygmalion Effect; an overview of Emotions and feelings, Values, Beliefs and Attitudes with Managerial Implications.

Learning: Concept- Theories of Learning: Conditioning, Social Learning, Managerial Implication of Learning Theories. Reinforcement.

Motivation: Concept, Major Theories and Process of Motivation: Maslow's Need-Hierarchy Theory; Herzberg's Motivation-Hygiene Theory; Mcgregor's Theory X and Theory Y; Goal- Setting Theory; ERG Theory; Vroom's Expectancy Theory; Equity Theory; Managerial implications of Various Theories

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation, Case studies

UNIT -2

Leadership: Concept and Functions; Style and Theories of Leadership: Traits, Behavioural and Situational/ Contingency Groups of Theories; Inspirational approaches to Leadership; Charismatic Leadership, Transformational Leadership, and Transactional Leadership, Contemporary Leadership Roles; Challenges to the Leadership Construct; Substitutes and Neutralizers to Leadership.

Group Behaviour: Groups: Concept and Classification; Stages of Group Development;Group Structure; Roles and Norms; Premise and Issues; Group Decision-Making: Group vs Individual; Groupthink and Groups Shift; Group Decision Making Techniques and Process.

Conflict Management: Concept; Causes; Types; Stages; Effects; Management of Conflicts.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation, Case studies

UNIT - 3

Organisational Culture: Concept; Dominant Culture; Strong vs Weak Cultures ; Creating and Sustaining Culture; Employees Learning of The Culture; Creating a Customer-Responsive Culture.

Organisational Changes: Concept and Forces for Change; Managing Planned Changes; Resistance to Change; Approaches to Manage Organisational Change; Organisational Development; Culture-Boundedness of Managing the Change.

9 Hours

Pedagogy	Chalk and talk method, Power Point Presentation, Case studies

Course outcome (Course Skill Set)

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

CO 1 Describe the Nature and Characteristics, Determinants and Approaches of Organizational Behaviour. Describe the concepts of Perception, Attitudes and values and their implications.

CO 2 Describe the concepts of learning and motivation along with their managerial implications.

CO 3 Describe the concepts of Leadership along with their managerial implications.

CO 4 Discuss the concepts of group dynamics and conflict management along with their implications

CO 5 Discuss the concepts of Organization culture and change and conflict management along with their implications.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Robbins, SP Stephen P, Timothy Judge and Nehasika Vohra, Organisational Behaviour, 12th or 16th edition, Pearson Education, 2011.
2. Fred Luthans, Organisational Behaviour, 11th edition, Mc Graw Hill,2009.

REFERENCE BOOKS

1. W. Newstrom, John, Organisational Behaviour,10th edition, Tata Mc Graw –Hill 2009.
2. Paul Heresy, Kenneth H. Blanchard, and Dewey E. Johnson, Management of Organisational Behaviour: Leading Human Resources, 2008.
3. Dr SS Khanka, Organisational Behaviour, S. Chand & Co, New Delhi, 2008.
4. Sanghi Seema, Organisational Behaviour, Pearson, 2011

Web links and Video Lectures (e-Resources):

1. NPTEL course material related to operations management, operations research and entrepreneurship

Course Articulation Matrix :

Course Code / Name : 21MEE218 / ORGANIZATIONAL BEHAVIOR															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2								3	1					1
CO 2	2								3	1					1
CO 3	1								3	1					1
CO 4	3								3	1					1
CO 5	1									1					1

1: Low 2: Medium 3: High

Management Information System			
Course Code:	21MEE219	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. To understand meaning, concepts, importance of Management, information systems and structure, classification of MIS.
2. To know the meaning, concepts, types of Information and systems.
3. To learn the development of system for MIS.
4. To know the analysis and design of system for MIS.
5. To know the decision-making function in MIS and Business applications of MIS.

UNIT -1

Introduction: Framework of Management Information Systems: Importance's of MIS, Concepts of Management, information, system, Definition of MIS, information technology and MIS, nature and scope of MIS, MIS characteristics and functions. Structure and classification of MIS: structure of MIS, MIS classification.

Information concepts: Definition, types of information: strategic information, Tactical information, Operational information. Information quality, dimensions of information.

System concepts: Definition, Kinds of Systems, System related concepts, elements of systems, Human as an information processing system.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Development MIS: System development stages: System investigation, system analysis, system design, construction and testing, implementation, maintenance.

System development approaches (a brief introduction): waterfall model, prototyping, iterative enhancement model, spiral model.

System analysis: introduction, requirement definition, strategies for requirement definition, structured analysis tools: data flow diagram, data dictionary, decision trees.

System Design: objectives, conceptual design, design methods, detailed system design.

System Implementation process, Hardware & software selection, system maintenance, evaluation of MIS.

15 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Decision making and MIS: decision making, Simon's model of decision making, types of decisions, purpose of decision making, level of programmability, knowledge of outcomes, methods of choosing among alternatives, decision making and MIS.

Business applications of MIS: Introduction, Cross-functional Enterprise Information system, e-Business & e-Commerce.

Brief introduction of functional information system, financial information system, marketing information

system, production/ Manufacturing information system, human resources information system

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:

CO 1 Explain meaning, concepts, importance of Management, information systems and structure, classification of MIS.

CO 2 Explain the meaning, concepts, types of Information and systems.

CO 3 Describe the development of system for MIS.

CO 4 Analyze and design the system for MIS.

CO 5 Describe the decision-making function in MIS and Business applications of MIS.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Robert G. Murdick & Joel E. Ross & James R. Claggett, “Information Systems for Modern Management” PHI.
2. D. P. Goyal, “Management information systems”, Macmillan India Ltd.
3. Waman S Jawadekar : Management Information Systems , Third Edition, Tata McGraw Hill, 2007.
4. James A O’Brien and George M Marakas : Management Information Systems, Seventh Edition, Tata McGraw Hill, 2006.

REFERENCE BOOKS

1. Bentley,”System Analysis and Design”, TMH
2. A. Ziya Aktas, “Structured Analysis & Design of Information System”, PHI.
3. V. Rajaraman, “Analysis & Design of Information Systems”, PHI.
4. J. Kanter, “Management Information Systems”, PHI.
5. G.B. Davis & M.H. Olson, “Management Information Systems”, McGraw Hill International.
6. Ralph M Stair and George W Reynolds: Principles of Information Systems, 7th Edition, CEngage Learning, 2010.

7. Steven Alter: Information Systems - The Foundation of E-Business, 4th Edition, Pearson Education Asia. 2011
8. Mahadeo Jaiswal and Monika Mittal: Management Information System, 3rd Edition, Oxford University Press..

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/110105148
2. https://www.mooc-list.com/go/4070

Course Articulation Matrix :

Course Code / Name : 21MEE219/ MANAGEMENT INFORMATION SYSTEM															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1					1	1		1		3				1
CO 2	1					1	1		1		3				1
CO 3	1					1	1		1		3				1
CO 4	1	2		3	3	1	1	1	1	1	3				1
CO 5	1	1				1	1	1	1	1	3	1	1		1

1: Low 2: Medium 3: High

Introduction to Financial Management			
Course Code:	21MEE221	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. To understand concepts and foundations of managing finance, to introduce various methods of financial statement analysis and to introduce the concept of risk and return.
2. To discuss with tools and techniques for Capital Budgeting and Firm Value analysis.
3. To provide the students with the knowledge of and Working capital management and Long-Term Financing
4. To discuss and Merger Acquisition/ Restructuring and Securities and Portfolio Analysis
5. To explain financial management practices in Indian companies and Global enterprises

UNIT -1

Introduction: Evolution of Financial Management, Goals, Forms of Business.

Financial Statement Analysis: Ratio analysis, time series analysis, Du pont analysis, funds flow analysis.

Risk and Required Return: Risk and return relationship, Business risk, financial risk, and risk in portfolio context, expected rate of return,

Capital Budgeting: Risk analysis in Capital Budgeting, Cost of Capital – Debt, Preference Equity forms of capital.

Capital Structure and Firm Value: Assumption, Definition and approaches, Capital Structure decisions – EBIT, EPS analysis, ROI, REI analysis and Cash Flow comparative Analysis.

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT -2

Working Capital Management: Factors influencing working capital requirement, determination of operating cycle and working capital.

Long Term Financing: Raising of finance form primary and secondary markets, Features of convertible securities and warrants and their valuation, SEBI guide lines on capital issues, Structure of stock market in India, Venture capital, Initial Public Offering.

Merger Acquisition and Restructuring: Reasons, Mechanics, Cost and benefits of a merger, Evaluation, purchase of a division, Takeovers, Acquisitions, Securities and Portfolio Analysis: Derivatives, Futures Trading

16 Hours

Pedagogy	Chalk and talk method, Power Point Presentation

UNIT - 3

Financial Management in Sick UNIT s: Definition of sickness, Causes of sickness, Symptoms of sickness, Prediction of sickness, Revival of a sick UNIT

International Financial Management: World Monitoring system, Foreign Exchange Markets, International Parity Relationships, International Capital budgeting, Financing Foreign Operations, Raising Foreign Currency Finance, Financing Exports, Documents in International Trade.

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:

CO 1 Discuss the concepts and foundations of managing finance. Determine Liquidity, Leverage, Activity and Profitability ratios through financial statement analysis. Compute the risk and return of business enterprises using the concept of expected value and variance.

CO 2 Discuss the various concepts of capital budgeting. Apply the concept of risk and return to explain capital budgeting as investment options. Apply ROI-ROE and EBIT equivalence method to choose the optimal capital structure. Calculate cost of debt, cost of equity, cost of preference shares, and cost of term loans from the given information.

CO 3 Discuss the components of working capital. Compute the operating cycle. Describe the sources of long term finance and methods of generating them.

CO 4 Discuss the reasons and mechanics (legal, tax and accounting aspects) of a merger. Compute costs and benefits of mergers.

CO 5 Discuss the causes and symptoms of sickness of business UNIT s. Explain the steps involved in revival of sick UNIT s. Explain the role of World Monetary Fund, Exchange rate system and methods of financing foreign operations (long term, intermediate terms and short term) and exports.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Financial Management Theory and practice – Prasanna Chandra – TMH – ISBN– 007-044501-X, 5th edn. 2011
2. Financial accounting – B.S. Raman – UNIT ed publication – VoI II,2006

REFERENCE BOOKS

1. Financial Management Text & Problems – Khan & Jain – TMH – ISBN 0—07-460208-X, 2011
2. Financial management – IM Pandey – Vikas Pub. House – ISBN 0- 7069-5435-1, 2011

Web links and Video Lectures (e-Resources):

1. NPTEL course material related to operations management, TQM, operations research

Course Articulation Matrix :

Course Code / Name : 21MEE221/ INTRODUCTION TO FINANCIAL MANAGEMENT															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	3	1								3				1
CO 2	1	3	1								3				1
CO 3	1	3	1								3				3
CO 4		2	1								3				3
CO 5		2									2				3
1: Low 2: Medium 3: High															

Innovation and Entrepreneurship			
Course Code	21MEE222	CIE Marks	50
Teaching Hours/Week(L:T:P:S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	3	Exam Hours	3

Course Learning Objectives:

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 -1

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.

14 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT -2

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

14 Hours

Pedagogy	Chalk and talk, Power point presentation, Videos

UNIT -3

INTRODUCTION TO TECHNOLOGICAL ENTREPRENEURSHIP 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.

11 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

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.

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Carayannis, Elias G., Samara, Elpida T., Bakouros, Yannis L., —Innovation and Entrepreneurship Theory, Policy and Practice||, Springer,2015.

REFERENCE BOOKS

1. Dick Whittington, —Digital Innovation and Entrepreneurship||, Cambridge University Press,2018.

Web links and Video Lectures (e-Resources):

Course Articulation Matrix :

Course Code / Name : 21MEE222/ INNOVATION AND ENTREPRENEURSHIP														
Course Outcomes (CO)	Program Outcomes (PO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2				1	1		1			1			2
CO 2	3	2				1	1		1			1			2
CO 3	2	2				1	1		1			1			2
CO 4	2	2				1	1		1			1			1
CO 5	3	2				1	1		1			1			1
1: Low 2: Medium 3: High															

Micro-Electro-Mechanical Systems (MEMS)			
Course Code:	21MEE223	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Understand the fundamental principles of MEMS and their applications.
2. Explain the capabilities and limitations of important micromachining techniques
3. Understand the concepts of Micro-mechanics micromachining
4. Understand the applicability of various sensors and actuation systems of MEMS
5. Understand the basic concepts of thermal and fluidic MEMS.

UNIT - 1	
Micro-Electro-Mechanical Systems : Introduction and overview, Principles of MEMS, Silicon as a Mechanical Material, Benefits of MEMS, Scaling and performance, Cost reduction, complexity, Issues to consider, MEMS Markets, Overview of MEMS applications. **Micromachining Techniques :** Overview, Capabilities and limitations of micromachining, Materials for micromachining, Substrates, Additive films and materials, Micromachining terms, General properties of common semiconductors, Mechanical properties, Native oxides of silicon, Typical silicon wafer types, Micromachining Techniques – Bulk Micromachining, Wet etching of silicon, Isotropic etching, Anisotropic etching, EDP, KOH, TMAH, Etch stop layers, Masking, Mask erosion around edges, bulk micromachining process flow, Electrochemical etching, Etch stop, Porous silicon, One- sided wafer etching, Vapor phase etching (XeFR2R), Dry etching, SFR6R, DRIE, Bosch process, Cryogenic dry etching, Sidewall roughness, Etch lag, Combined isotropic and anisotropic dry etching, SCREAM, ASIP **Micromachining Techniques:** Surface Micromachining, Thin film processes, Oxide (thermal, deposited LTO), Nitride (stoichiometric, low-stress), Poly (stress, stress-gradients), Metal, surface micromachining process flow, Release, Wet–Stiction, Dry - Critical point drying, Vapor HF, Microelectronic integration – prior, mixed and post, Electro-deposition, Hybrid Micromachining **16 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT -2	
Micro-Mechanics: Basic Mechanics, Axial stress & strain, Shear stress & strain, Poisson's Ratio, Commonly used deflection equations, Static beam equations, Static torsion equations, Static plate equations, Cantilever beams, Clamped-clamped beams, Membranes **Springs** – folded, torsional, Dynamics, Spring-mass-damper system, resonance, Test structures, Elastic properties, Bent Beam Method for determining Young's modulus **Resonant beam structures:** Cantilever beam, Comb drive resonator, Stress/Strain Gauges - Bent beam strain sensor, Cantilever beams, Buckling beam structures, Substrate analysis; Stoney Equation, Basic mechanisms and structures, In-plane rotary mechanisms, Out-of-plane mechanisms, Bistable mechanisms, Mechanical Sensors, Resistive and piezoresistive strain sensors, Semiconductor strain gauges, Capacitive sensing, Micromachined mechanical sensors **Accelerometers:** Basic accelerometer concepts, Force-balanced accelerometer concepts, Strain guage accelerometers, Capacitive accelerometers, Gyroscopes, Pressure sensors, Piezoresistive pressure sensors, Capacitive pressure sensors, Electrostatics, Actuation mechanisms, Electrostatic actuation, Parallel plate actuators, Torsional electrostatic actuators, Electrostatic comb drives, Electrostatic cantilever actuators, Electrostatic linear micromotors (scratch drive), Electrostatic rotary micro-motors. **14 Hours**	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT - 3	
Thermal MEMS: Thermal actuators, Thermal expansion of solids, Bimorph thermal actuators, Bent beam actuators, Thermal array actuators, Volume expansion and phase-change actuators, Thermal sensors, Bolometers, Uncooled bolometers, Air flow sensor. **Fluidic MEMS :** Introduction, Basic fluid properties and equations, Types of flow, Bubbles and particles in microstructures, Capillary forces, Fluidic resistance, Fluidic capacitance, Fluidic inductance, Flow channels, Bulk micromachined channels, Surface micromachined channels, Valves – Passive valve, Active	

valves, Pumps, Bubble pumps, Membrane pumps, Diffuser pumps, Rotary pumps, Electro-hydrodynamic pumps, Electrophoretic pumps, Droplet generators

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:

CO 1 Describe the basics and capabilities and limitation of MEMS.

CO 2 Explain and differentiate important micromachining techniques

CO 3 Apply the concepts of Micro mechanics and materials for micromachining

CO 4 Describe sensors and actuation systems used in MEMS

CO 5 Explain the basics of thermal and fluidic MEMS..

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:

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:

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

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

TEXTBOOKS:

1. Micromachined Transducers Sourcebook, Greg Kovacs, McGraw-Hill publications, New York, 1998
2. Microsystem Design, Stephen D. Senturia, Kluwer Publications, Boston, 2001

REFERENCE BOOKS

1. MEMS/NEMS – Handbook: Techniques and Applications, Cornelius T. Leondes, Springer-Verlag Publications, 2005
2. Fundamentals of Microfabrication, Marc J. Madou, Taylor & Francis Publications, 2nd, 2002

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/117/105/117105082/
2. https://nptel.ac.in/courses/108/108/108108113/
3. https://nptel.ac.in/courses/112/108/112108092/
4. https://nptel.ac.in/courses/108/106/108106165/
5. https://www.udemy.com/course/introduction-to-micro-and-nano-fabrication-techniques-by-essamberikaa/

Course Articulation Matrix :

Course Code / Name : 21MEE223 / MICRO-ELECTRO-MECHANICAL SYSTEMS (MEMS)															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	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	PSO 3
CO 1	3		1									1	3		2
CO 2	3		1									1	3		2
CO 3	3		2									1	3		2
CO 4	3		2									1	3		2
CO 5	3		1									1	3		2
1: Low 2: Medium 3: High															

Cloud Computing			
Course Code:	21MEE226	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	39	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Outline the fundamental ideas behind Cloud computing, and the evolution of the paradigm, its applicability, benefits as well as current and future challenges.
2. Get the basic idea and principles in Datacentre design and Management and find the importance of Virtualization in Cloud.
3. Get the idea of different Cloud deployment models and Cloud Delivery Models and their security issues.
4. Tellhow Cloud Computing solves different problems in the present by considering different
5. Cloud Vendors and their Cloud Design architecture.

UNIT -1

Eras of computing, Parallels, Distributed Computing,

Elements of Parallel Computing- (What is parallel computing, hardware architecture for Parallel processing, approaches to parallel programming, levels of parallelism, Laws of caution).

Elements of Distributed Computing- (General concepts and definitions, components of a distributed system, Architectural styles for distributed computing, models for inter-process communication, Technologies for distributed computing-Remote procedure call, Service oriented computing). Classic data center, its elements, challenges, and benefits. Data center management Steps in transitioning to cloud-consolidation, automation, IT as a service.

Cloud computing Architecture- Introduction, Cloud reference models- (Architecture, Infrastructure/Hardware as a service, Platform as a service, Software as a service), Types of cloud – (Public Clouds, Private Clouds, Hybrid Clouds, CommUNIT y Clouds), Economics of cloud, Open

challenges. 15 Hours	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT -2	
Virtualization– Introduction, characteristics of virtualized environments, taxonomy of virtualization technique- (execution of virtualization, other types of virtualizations- Compute, Storage, Network, Desktop, Application). Virtualization and cloud computing, Pros and Cons of virtualization, **Technology examples-** XEN, VMware, Microsoft Hyper- V. Security Concerns, **Risk Issues-** Cloud Computing- Security Concerns. A Closer Examination: Virtualization, A Closer Examination: Provisioning. 15 Hours	
Pedagogy	Chalk and talk method, Power Point Presentation
UNIT - 3	
The Purpose of Security Monitoring, Transforming an Event Stream, The Need for C.I.A. in Security Monitoring, the OpportUNIT y for MaaS. **Case studies:** Public cloud- AWS, Windows Azure, Google App Engine. Private Cloud- Open stack, Eucalyptus. 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:** **CO 1** Define the concept of cloud computing business need and various networking methods. **CO 2** Explain the infrastructure management for cloud environment. **CO 3** Describe the Virtualization at all levels using technology XEN, Vmware, Microsoft Hyper-v. **CO 4** Explain the security concepts in cloud computing and securing the cloud. **CO 5** Present case studies of public cloud such as AWS, Google App Engine and private cloud such as OpenStack.	

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:

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:

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 full questions carrying equal marks.
2. Each full question will be for 20 marks.
3. There will be two full questions (with a maximum of four sub- questions) from each module.
4. Each full question will have sub- question covering all the topics under a module.

Suggested Learning Resources:

Textbooks:

1. Buyya, Rajkumar, Christian Vecchiola and ThamaraiSelvi, "Mastering Cloud Computing Fundamentals and Applications Programming", McGraw Hill,2013.
2. G, Somasundarm and Alok Srivatsa, "Information Storage and Managemnt.", EMC Education Services, Wiley Publishing Inc., 2009.
3. Sitaram, Dinakar and Geetha Manjunath,"Moving to the Cloud – Developing Apps in the World of Cloud Computing", Elsevier,2012.
4. Sosinsky, Barrie, "Cloud Computing Bible.", Wiley India Pvt. Ltd, 2013.
5. Winkler, Vic (J.R), "Securing the Cloud - Cloud Computer Security Techniques and Tactics", Elsevier Inc., 2012.

REFERENCE BOOKS

1. Hurwitz, Judith, "Cloud computing for dummies", Wiley India Pvt Ltd,2011.
2. Rittinghouse, John, "Cloud computing – implementation, management and security", CRC Press, First edition,2009.
3. Velte, Toby, Anthony Velteand Robert Elsenpete "Cloud Computing, A Practical Approach.", Tata McGraw-Hill Authors, 2010.

Web links and Video Lectures (e-Resources):

E-Books / Online Resources:

1. www.motc.gov.qa/sites/default/files/cloud_computing_ebook.pdf
2. http://eddiejackson.net/web_documents/The_Definitive_Guide_to_Cloud_Computing.pdf

MOOC:

1. http://nptel.ac.in/courses/106106129/28
2. https://www.coursera.org/learn/cloud-computing

Course Articulation Matrix :

Course Code / Name : 21MEE226 / **Cloud Computing**															
Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3				1							1			
CO 2	3				1							1			
CO 3	3				2							1			
CO 4	3				1							1			
CO 5	3				1							1			
1: Low 2: Medium 3: High															

OPEN ELECTIVE - (VII Semester) – 2024

Sl. No	Code	Name	Intake
1.	**21HU8X03**	**Intellectual property rights** *(for all except Robotics & except for those who have taken the subject in the VI semester)*	65
2.	**21CV8X07**	**Environment Impact Assessment** *(for all except Civil & except for those who have taken the subject in the VI semester)*	60
3.	**21ME8X08**	**Industrial Pollution Control** *(for all except Mechanical & except for those who have taken the subject in the VI semester)*	60
4.	**21EE8X10**	**Non-Conventional Energy Systems** *(for all except EE, Mech.)*	60
5.	**21CS8X15**	**Essentials of Information Technology** (for all except CS, CCE, AIML & IS)	60
6.	**21EC8X18**	**Consumer Electronics** (for all except EC)	60
7.	**21ME8X28**	**Operations Management and Entrepreneurship** *(for all exceot Robotics, Mechanical & except for those who have taken the subject in the VI semester)*	60
8.	**21ME8X33**	**Human Resource Management** (for all except Mechanical)	60
9.	**21HU8X37**	**Linguistics and Language Technology** (for all)	60
10.	**21BT8X40**	**Bio Fuel Engineering** (for all except BT & *except for those who have taken the subject in the VI semester)*	60
11.	**21ME8X65**	**Automotive Engineering** (For all except Mechanical)	60
12.	**21CV8X67**	**Disaster Management** (For all except Civil)	60
13.	**21HU8X68**	**Introduction to Yoga** *(for all except for those who have taken the subject in the VI semester)* ***(The classes will be conducted from 6.30 a.m. to 7.30 a.m.)***	50
14.	**21HU8X70**	**Overview of Indian Culture and Arts** (for all *except for those who have taken the subject in the VI semester)*	50
15.	**21HU8X71**	**Principles of 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) & for all *except for those who have taken the subject in the VI semester*	50
16.	**21HU8X72**	**Introduction to Japanese language** (for all) (Students with no backlogs, CGPA should be above 7.0 & who have intention to work for Japanese companies in India or Japan) – **Registration fee for this subject is Rs.1500/- & classes will be held on Saturday)**	60
17.	**21ME8X75**	**Sustainable Development Goals** (for all *except for those who have taken the subject in the VI semester)*	60
18.	**21CS8X80**	**Internet of Things** (for all except EC, CS, CCE, AIML, IS & Robotics)	30
19.	**21IS8X83**	**Software Engineering Practices** (for all except CS, AIML, CCE & IS)	60
20.	**21IS8X84**	**Introduction to Cyber Security** (for all except CS, CCE & IS)	60
21.	**21EC8X85**	**Space Technology & Applications** (for all except E&C)	60
22.	**21ME8X88**	**Marketing Management** (for all except Mechanical & *those who have taken the subject in the VI semester)*	60
23.	**21CC8X94**	**Next Generation Wireless Networks** (for all except CCE & *except for those who have taken the subject in the VI semester)*	60
24.	**21AI8X95**	**Introduction to Artificial Intelligence & Machine Learning** (for all except AIML, CCE, CS, IS & Robotics & *except for those who have taken the subject in the VI semester)*	60
25.	**21RI8X91**	**Micro Aerial Vehicle** (for all except Robotics)	40
26.	**21CV8X96**	**Sustainability Engineering** (for all)	60

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, 2017	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→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													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., 2007
2.	Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007
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 2001,
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 policy options, Zed Books, New York 2000
8.	Wadehra, B. L. Law relating to patents, trademarks, copyright designs & geographical indications 2 ed. Universal Law Publishing 2000
9.	Sinha, Prabhas Chandra Encyclopedia of Intellectual Property Rights, 3 Vols. Eastern Book Corporation, 2006.
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/

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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**

Course Learning Objectives:

This Course will enable students to

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

UNIT – I

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

16 Hours

UNIT - II

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

10 Hours

UNIT – III

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

13 Hours

Course Outcomes:

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

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

Course Articulation Matrix :

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. 2010. 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, 2009. Methods of Environmental Impact Assessment, 3rd edition. New York, NY: Routledge.
2. Hanna, K.S. 2009. Environmental impact assessment. Practice and Participation. 2nd edition. Oxford, University Press, Don Mills, Ontario.

NPTEL SOURCES

http://nptel.ac.in/courses/120108004/
http://nptel.ac.in/courses/120108004/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

Scheme of SEE Question Paper

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

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NON-CONVENTIONAL ENERGY SYSTEMS			
Course Code	**21EE8X10**	**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 and Mechanical Engineering

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

Course Learning Objectives (CLO):

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

UNIT – I

Energy Sources: Introduction, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Classification of Energy Resources, Conventional Energy Resources- Availability and their Limitations, Non-Conventional Energy Resources- Classification, Advantages, Limitations, Comparison of Conventional and Non-Conventional Energy Resources, World Energy Scenario, Indian Energy Scenario.

3 Hours

Solar Energy Basics: Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (numerical problems), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical problems), Measurement of Solar Radiation Data – Pyranometer and Pyrheliometer.

5 Hours

Solar Thermal Systems: Principle of Conversion of Solar Radiation into Heat, Solar Water Heaters (Flat Plate Collectors), Solar Cookers – Box type, Concentrating dish type, Solar driers, Solar Still, Solar Furnaces, Solar Green House.

4 Hours

Solar Electric Systems: Solar Thermal Electric Power Generation, Solar Pond and Concentrating Solar Collector(Parabolic Trough, Parabolic Dish, Central Tower Collector), Advantages and Disadvantages; Solar Photovoltaic – Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Solar PV Systems- stand-alone and grid connected, Applications- Street lighting, Domestic lighting and Solar Water pumping systems.

4 Hours

UNIT – II

Energy Storage: Introduction, Necessity of Energy Storage and Methods of Energy Storage (Classification and brief description using block diagram representation)

4 Hours

Wind Energy: Introduction, Wind and its Properties, History of Wind Energy Wind Energy Scenario – World and India. Basic principles of WECS, Classification, Parts of a WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS. Wind site selection consideration, Advantages and Disadvantages of WECS.

4 Hours

Biomass Energy: Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production

from waste biomass, Factors affecting biogas generation, types of biogas plants- KVIC and Janata model, Biomass program in India

6 Hours

UNIT – III

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

5 Hours

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

4 Hours

Course Outcomes:

At the end of the course student will be able to

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

Course Outcomes: Mapping with Program Outcomes												
Program Outcomes→ ↓ **Course Outcomes:**	1	2	3	4	5	6	7	8	9	10	11	12
21EE8X10.1	2	3				1	2	1				
21EE8X10.2	2	3				1	2	1				
21EE8X10.3	2	3				1	2	1				
21EE8X10.4	2	3				1	2	1				
21EE8X10.5	2	3				1	2	1				

1: Low 2: Medium 3: High

SEE Question Paper Pattern:

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

TEXTBOOK:

1. Rai G. D., "Non-Conventional Sources of Energy", 4th Edition, Khanna Publishers, New Delhi, 2007

REFERENCE BOOKS:

1. Mukherjee D. and Chakrabarti, S., "Fundamentals of Renewable Energy Systems", New Age International Publishers, 2005.
2. Khan, B. H., "Non-Conventional Energy Resources", TMH, New Delhi, 2006
3. S. P. Sukhumi, J. K. Nayak "Solar Energy: Principles Collection and Storage", 3rd edition, McGraw-Hill Education (India) , 2009

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ESSENTIALS OF INFORMATION TECHNOLOGY			
Course Code	**21CS8X15**	**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. Outline the fundamentals of python programming.
2. Implement the object oriented concepts using python programming.
3. Describe the basic concepts of Relational Database Management System.
4. Apply the normalization to the Databases and develop databases using SQL and PL/SQL Queries.
5. Develop the data base connectivity in integration with python and perform various Database operations.

UNIT - I

PROGRAMMING FUNDAMENTALS Introduction to Programming: Why Programming, What is Computer Program, What is an Algorithm, Flowchart, Pseudo Code; Python Fundamentals: – Introduction to python, Variables and Data Types, Comments, Input Function, Operators, Coding Standards, Integrated Development Environment(IDE) ;Control Structures: Selection Control Structures, ,Looping/Iterative Control Structures; Data Structures: String , List, Dictionary and Tuple ,Set, Functions: Built-in functions, User-defined Functions, Recursion.

OBJECT ORIENTED PROGRAMMING USING PYTHON Introduction to Object Oriented Paradigm: Abstraction and Entity, Encapsulation and Data hiding, Class and Object, Unified Modelling Language (UML), Object Oriented Approach, Class Variables, Class methods and Static Methods, Documentation, Inheritance & Polymorphism: UML: is-a relationship
(Generalization), Types of Inheritance, Multiple Inheritance, Polymorphism, Benefits of OOP,
Memory Management in Python, Relationships: has-a relationship: Aggregation & Composition, uses-a relationship; File handling, Exception Handling, Raising Exceptions

15 Hours

UNIT - II

RELATIONAL DATABASE MANAGEMENT SYSTEM Data and Need for DBMS: Data – Is it important, What is Data, Do we need to store data, How to Store / Handle Data, What is DBMS and its Models, Functional Needs of DBMS, Data perspectives in DBMS; Relational Model and Keys: What is RDBMS, Data representation in RDBMS, Keys in RDBMS; Database Development Life Cycle; Data Requirements; Logical Database Design: Different Approaches in Logical Design, ER Modeling, ER Notations, Steps in ER Modeling; Physical Database Design: Converting ER Model to Relational Schema ;Normalization: Functional Dependency, First
Normal Form: 1NF, Second Normal Form: 2NF, Third Normal Form: 3NF, Normalization
Guidelines;

Implementation with SQL: What is SQL, Data types and Operators in SQL, SQL Statements: SQL - Built-in Functions; SQL - Group by and Having Clauses Joins: Inner Join, Outer Join, Self-Join, Sub Queries: Independent Sub queries, Correlated Sub queries, Index, Views,
Transactions, PL/SQL

15 Hours

UNIT - III

PYTHON DATABASE INTEGRATION Why Database Programming, Python Database
Integration – Pre-requisites and Installation, SELECT Operation: Retrieve Data from Database, Attributes of Cursor object, Bind variables, CREATE and INSERT Operation: Creating a table, Insert Operation, Inserting Multiple Records, UPDATE Operation, DELETE Operation, Exception Handling.

9 Hours

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

1. Explain the basic program constructs of Python Programming.
2. Design and apply the object oriented programming construct using Python to build the real world application.
3. Summarize the concepts related to Relational Database Management System.
4. Design and develop databases from the real world by applying the concepts of Normalization using SQL and PL/SQL.
5. Perform the various Database operations by connecting Python with Database.

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	1	2	3		1				1	1		1		3	
CO2	1	2	3		1				1	1		1		3	3
CO3	1	2	3											3	
CO4	2	3												3	3
CO5	1	2	3		1				1	1		1		3	2

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

TEXTBOOKS:

1. Kenneth A. Lambert, "The Fundamentals of Python: First Programs, 2012", Cengage Learning.
2. Magnus Lie Hetland, "Beginning Python from Novice to Professional", Second Edition.
3. Mark Summerfield, Programming in Python 3 – "A Complete Introduction to the Python Language", Second Edition.
4. Elmasri, Navathe, "Fundamentals of Database Systems", Third edition, Addison Wesley

REFERENCE BOOKS:

1. Y. Daniel Liang, "Introduction to Programming Using Python", Pearson, ISBN:9780-13274718-9, 2013.
2. Raghu Ramakrishnan and Johannes Gehrke: "Database Management Systems" (Third Edition), McGraw-Hill, 2003.

SEE SCHEME:

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

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CONSUMER ELECTRONICS			
Course Code	**21EC8X18**	**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. Learn and design operating principles of "real world" electronic devices
2. Study broader view of key principles of electronic device's operation and presents a block circuit diagram.
3. Learn to integrate the many different aspects of emerging technologies and able to build unique mix of skills required for careers.

UNIT – I

Sound: Properties of sound and its propagation, Transducers (Micro Phone, Loud Speakers), enclosures, mono-stereo, Amplifiers, Multiplexers, mixers, Synthesizers.
Vision: B/W TV, CTV concepts, B/W & Color Cameras, Displays.

15 Hours

UNIT – II

Recording and Playback: Optical discs; recording and playback, audio and video systems, Theatre Sound, Studios, Editing.
Communications and Broadcasting: Switching Systems, Land lines, Modulation, Carrier, Fiber optics, Radio and TV broad casting
Data Services: Data services, mobiles, terrestrial & Satellite Systems, GPS, Computers, internet Services.

15 Hours

UNIT – III

Utilities: Fax, Xerox, Calculators, Microwave ovens, Washing Machines, A/C & refrigeration, Dishwashers, ATMS, Set -Top boxes, Auto Electronics, Industrial Electronics, Robotics, Electronics in health / Medicine, nano- technologies.

9 Hours

Course Outcomes:

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

1. Recall basics of sound.
2. Recall basics of television and camera.
3. Explain basic working of Recording, storage devices,
4. Explain basics of communication and broadcasting.
5. Recall basic working of commonly used electronic gadgets

TEXTBOOKS:

1. Anand, **"Consumer Electronics",** Khanna publications, 2011.
2. Bali S. P., **"Consumer Electronics",** Pearson Education, 2005.

REFERENCE BOOK:

1. Gulati R. R., **"Modern Television Engineering",** Wiley Eastern

Scheme of SEE Question Paper

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

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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, 2005.
4. **Total Quality Management**: Dale H. Besterfield, Pearson Education, 2003.
5. **Dynamics of Entrepreneurial Development & Management** – Vasant Desai – Himalaya Publishing House
6. **Entrepreneurship Development** – Poornima.M.Charantimath – Small Business Enterprises – Pearson Education – 2006 (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. 2005, 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:21ME8X28/ 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 **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I** & **Unit – II** and **1** full question from **Unit – III**.

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HUMAN RESOURCE MANAGEMENT			
Course Code	**21ME8X33**	**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) To develop a meaningful understanding of HRM theory, functions and practices.
2) To understand concepts and skills recruitment.
3) To understand the concepts of training and development.
4) To deal with employees' grievances, safety and health types of organizations.
5) To understand the concepts of e-HRM.

UNIT - I

Human Resource Management & HRP:
Introduction, meaning, nature, scope of HRM. Major functions of HRM, Personnel Management vs Human Resource Management, job design, job evaluation, job analysis, job specification, job enlargement, job enrichment. Role of HR Manager.HR Planning. Process HRP.
8 Hours

Recruitment: Definition, Sources and Methods of Recruitment
Selection: Definition and Process of Selection. Cost benefit analysis of selection.
Placement: Meaning, Induction/Orientation, Internal Mobility, Transfer, Promotion, Demotion and Employee Separation. Performance Appraisal methods
8 Hours

UNIT – II

Training and development: Training v/s development, stages in training, Training Methods, Executive Development, Methods and Development of Management Development, Career and Succession Planning.
Compensation: employee remuneration, rewards, Wage and Salary Administration, Bonus, fringe benefits. Internal Mobility, External Mobility, Trade union Act (Amendment) 2001.
7 Hours

Employee Grievances: Employee Grievance procedure. Discipline procedure
Collective bargaining; Characteristics, Necessity, Forms
Safety & Health; Industrial accidents, Safety
Quality circle; Meaning, Structure
8 Hours

UNIT – III
IHRM. Managing IHRM. e-HR Activities, Global recruitment, selection, expatriates. Industrial conflict – Causes, Types, Prevention and Settlement. **e-HRM**; Aspects of e-HRM,e-Job design & Analysis, Ethical issues in employment **8 Hours**
Course Outcomes (CO):
At the end of the course the student will be able to:
CO 1 Describe the basic concepts of HRM & HRP.
CO 2 Elucidate the HRM functions of recruitment, selections, appraisal etc.
CO 3 Apply the training, development and compensation methods in HRD.
CO 4 Identify the employee grievances and to spell out the remedial measures.
CO 5 Infer the concepts of e-HRM and I-HRM.
TEXTBOOK:
1. Essentials of Human Resource Management & Industrial Relations-P Courseba Rao, Third Revised Edition
REFERENCE BOOKS:
1) Human Resource Management - John M. Ivancevich, 10/e, McGraw Hill.
2) Human Resource Management-Flippo
3) Human Resource Management - Lawrence S. Kleeman, Biztantra , 2012.
4) Human Resource Management – Aswathappa K HPH
MOOC/NPTEL Resources:
1) http://edx.nimt.ac.in/courses/course-v1:nimtX+PGDM1212+2017_H1/about
2) http://nptel.ac.in/courses/122105020/

Course Articulation Matrix

Course Code / Name : 21ME8X33 / HUMAN RESOURCE MANAGEMENT														
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C- 21ME8X33.1	3	-	-	-	-	1	-	-	1	1	-	1	-	-
C-21ME8X33.2	3	-	-	-	-	1	-	-	1	1	-	1	-	-
C-21ME8X33.3	3	-	-	-	-	1	-	-	1	1	-	1	-	-
C-21ME8X33.4	3	-	-	-	-	1	-	-	1	1	-	1	-	-
C-21ME8X33.5	3	-	-	-	-	1	-	-	1	1	-	1	-	-

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

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

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LINGUISTICS & LANGUAGE TECHNOLOGY

Course Code	**21HU8X37**	**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.	Introspect about the consciousness in one's language
2.	Learn pronunciation and how the process helps to communicate effectively.
3.	Build contextual speech and writing with the pedagogy in sentence structure.
4.	Improve skill of applying language to enunciate words.
5.	Progress on the speech aspects by understanding the acquisition of Second Language.

UNIT - I

Introduction to Linguistics Broad understanding of Linguistics, Language and characteristic features, Scientific Language, Levels of Linguistic Analysis (Phonetics, Phonology, Morphology, Syntax and Semantics); Approach to Linguistics (Traditional, Structural and Cognitive).	8
Phonology and Morphology Perspectives in Linguistics, Phonemes, Allophones, Phonemic Analysis, Morphology and Morphemes, Word building process, Morphological Analysis.	8

UNIT - II

Syntax Constituent structure (Simple Sentence, Noun Phrase, Verb Phrase, Prepositional Phrase, Adjective Phrase, Adverb Phrase, Structure Rules), Tree Diagrams, Case	16

UNIT – III

Sociolinguistics & Psycholinguistics, Artificial Intelligence Notion of Language Variety, Languages in Contact, Language and Mind, Error Analysis.	7

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

1.	Understand the importance of language and its facets.
2.	Demonstrate knowledge of sounds and competence in process of word building.
3.	Evolve to reason the constituent parts of a sentence.
4.	Understand the techniques of how 'meaning' is applied.
5.	Analyze errors in day-to-day-conversations and how language is related to society.

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	PSO↓ 2
CO1		1			1	1			1			2		
CO2			2						2	2				
CO3	2	3		3					3	2				
CO4					2				1	2				
CO5		2				2	1					1		

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Akmaijan, A, R. A. Dimers and R. M. Harnish. Linguistics: An Introduction to Language and Communication. London: MIT Press, 1979.
2.	Chomsky, Noam. Language in Mind. New York: Harcourt Brace Jovanovich, 1968.
3.	Fabb, Nigel. Sentence Structure. London: Routledge, 1994.
4.	Hockett, C. A Course in Modern Linguistics. New York: Macmillan, 1955.
5.	O'Grady, W., O. M. Dobrovolsky and M. Aronoff. Contemporary Linguistics: An Introduction. New York: St. Martin's Press, 1991.
6.	Pride, J. B. and J. Holmes. Sociolinguistics. Harmondsworth: Penguin, 1972.
7.	Richards, J. C. Error Analysis: Perspectives in Second Language Acquisition. London: Longman, 1974.
8.	Salkie, R. The Chomsky Update: Linguistics and Politics. London: Unwin Hyman Ltd., 1990.
9.	Sinclair, J. M. C. H. and R. M. Coulthard. Towards an Analysis of Discourse. Oxford: OUP, 1975.
10.	Thomas, Linda. Beginning Syntax. Oxford: Blackwell, 1993.
11.	Verma, S. K. and N. Krishnaswamy. Modern Linguistics: An Introduction. New Delhi: OUP, 1989.
12.	Wekker, Herman and Liliane Haegeman. A Modern Course in English Syntax. Kent: Croom Helm, 1985.

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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:

	PO											
CO	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, 2008.
2. Jonathan R.M, *Biofuels – Methods and Protocols (Methods in Molecular Biology Series),* Humana Press, New York, 2009.
3. Olsson L. (Ed.), *Biofuels (Advances in Biochemical Engineering/Biotechnology Series,* Springer-Verlag Publishers, Berlin, 2007.
4. Glazer, A. and Nikaido, H. *Microbial Biotechnology – Fundamentals of Applied Microbiology*, 2 Ed., Cambridge University Press, 2007.
5. Godfrey Boyle (Ed). *Renewable Energy- Power for sustainable future*, 3rd Ed. Oxford. 2012.
6. Ramachandran, T. V. *Management of municipal solid waste*. Environmental Engineering Series. Teri Press, 2016.

SEE QUESTION PAPER PATTERN:

Unit No.	I	II	III
Questions to ask (20 marks/Qn)	3	3	2
Questions to answer	2	2	1

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AUTOMOTIVE ENGINEERING			
Course Code	**21ME8X65**	**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	Get an idea on the different components of an engine and its types with lubrication system.
2	Understand the fuel supply system and ignition systems used in automobiles.
3	Demonstrate the working of transmission system.
4	Explain the importance of suspension system, steering geometry and drives in automobiles
5	Know the concept of braking system, tyres and emission control.
UNIT – I	

ENGINE COMPONENTS AND COOLING & LUBRICATION SYSTEMS:
SI & CI engines, Cylinder-arrangements and their relative merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams, Choice of materials for different engine components, engine positioning, cooling requirements, methods of cooling, thermostat valves, different lubrication arrangements, crankshaft/flywheel position sensor, accelerator pedal sensors, engine coolant water temperature sensor.

8 Hours

FUEL SUPPLY SYSTEMS FOR SI AND CI ENGINES: Fuel mixture requirements for SI engines, types of carburetors, simple carburetor, multi point and single point fuel injection systems, CRDI, fuel transfer pumps: AC Mechanical Pump, SU Electrical Pumps, injectors, Fuel gauge sensor, Throttle position sensor, Mass air flow sensors.

5 Hours

IGNITION SYSTEMS:
Battery Ignition systems, magneto Ignition system, Transistor assisted contacts. Electronic Ignition, Automatic

Ignition advance systems, Lighting systems, Rain/Light sensors, starting device (Bendix drive)

2 Hours

UNIT – II

POWER TRAINS:

Clutches- Single plate, multiplate and centrifugal clutches. Gear box: Necessity for gear ratios in transmission, Constant mesh gear box, Synchromesh gear box, principle of automatic transmission, Vehicle Speed Sensors, calculation of gear ratios, Types of transmission systems. No numerical.

8 Hours

DRIVE TO WHEELS:

Propeller shaft, universal joints, Hotchkiss. and torque tube drives, differential, rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe-in & toe-out, condition for exact steering, power steering, over steer, under steer & neutral steer, Steering angle sensors, numerical problems.

5 Hours

SUSPENSION AND SPRINGS:

Requirements, leaf spring, coil spring, Torsion bar suspension systems, independent suspension for front Wheel, Air suspension system**.**

2 Hours

UNIT – III

BRAKES:

Types of brakes, mechanical, compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, Drum brakes.

5 Hours

TYRES

Desirable tyre properties, Types of tyres.

1 Hour

AUTOMOTIVE EMISSION:

Automotive exhaust emissions, sources and emission control method: EGR, SCR, Emission Standards, Exhaust sensors.

Electric Vehicles.

3 Hours

Course Outcomes (CO):

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

CO 1	**Describe** and demonstrate the layout of an automobile and components of an automobile engine. Explain cooling and lubrication systems.
CO 2	**Explain** and demonstrate the fuel supply and Ignition systems for SI and CI engines.
CO 3	**Describe** and demonstrate the transmission system
CO 4	**Explain** and demonstrate the components of drive to wheel and suspension system, calculate the parameters of steering geometry.
CO 5	**Describe** and demonstrate automotive braking system. Explain types and construction of tyres and wheels. Explain the significance of automotive emissions and its controlling methods.

TEXTBOOKS:

1. Automotive Mechanics by S. Srinivasan, Tata McGraw Hill, 2003
2. Automobile Engineering, Kirpal Singh, Vol I and II, 2013.
3. Automotive Electrical and Electronics, A. K. Babu, Khanna Publishers, 2nd edition, 2016

REFERENCE BOOKS :

1. Automobile Engineering, R. B. Gupta, Satya Prakashan, 4th Edn., 1984 .
2. Automobile Engineering, Narang, Khanna Publishers 2002
3. Automotive Mechanics, Crouse, McGraw Hill 2002
4. Automotive Mechanics, Joseph Heithner 2000
5. Automobile Mechanics by N. K. Giri, Khanna publishers 2002
6. Newton and Steeds Motor Vehicle, Butterworth, 2nd Edn. 1989.
7. Automobile Engineering by K. K. Jain and R. B_ Arshana, Tata McGraw Hill, 2002
8. Automobile Mechanics, A.K. Babu & S.C. Sharma, T.R. Banga, Khanna Book Publishing
9. A Textbook of Automobile Engineering, R.K. Rajput, Laxmi Publications

List of proposed Experiments in Automotive Laboratory: 4 Hours

1. Study of Automotive - Chassis & superstructure/body and its functions. Also involves study of cut section of wheel & tyres (bias and radial types).
2. Study of more commonly used tools and equipment in automotive shop.
3. Study of carburetors and petrol & diesel fuel injection systems
4. Demonstration and study of Front axle and steering system
5. Demonstration and study of various suspension systems
6. Power train - Dismantling and assembly of single/multi cylinder Engine.
7. Power train - Study of clutch mechanism. Demonstration and study of dry friction clutches - Single plate & multi-plate types
8. Power train - Demonstration and study of transmission system - Gear box
9. Power train - Demonstration and study of Universal joints, propeller shaft, final drives, differential, and rear axles
10. Demonstration and study of brake mechanism (hydraulic type) and study of disc and drum brakes
11. Field visit to Automotive Servicing Station - Study of electrical system, wheel alignment (measuring and adjustment of castor, camber, king-pin inclination, toe-in and toe-out), automotive emission control systems.

(The details of each experiment to be given out as handout to each student or may be uploaded in Intranet)

Course Articulation Matrix:

Course Code / Name: 21ME8X65 / Automotive Engineering														
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C-21ME8X65.1	3	1	-	-	-	1	-	-	3	1	-	1	3	3
C-21ME8X65.2	3	1	-	-	-	1	-	-	3	1	-	1	1	3
C-21ME8X65.3	3	1	1	-	-	1	-	-	3	1	-	1	3	3
C-21ME8X65.4	2	3	1	-	-	1	-	-	3	1	-	1	2	3
C-21ME8X65.5	3	1	1	-	-	1	1	1	3	1	-	1	2	3

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

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

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DISASTER MANAGEMENT			
Course Code	**21CV8X67**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

1. Understand difference between Disaster, Hazard, Vulnerability, and Risk.
2. Know the Types, Trends, Causes, Consequences and Control of Disasters
2. Apprehend Disaster Management Cycle and Framework.
3. Know the Disaster Management in India
4. Appreciate Applications of Science and Technology for Disaster Management.

UNIT – I

Understanding Disasters: Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.

Types, Trends, Causes, Consequences and Control of Disasters: Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters

15 Hours

UNIT – II

Disaster Management Cycle and Framework: Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR,YokohamaStretegy, Hyogo Framework of Action

Disaster Management in India: Disaster Profile of India – Mega Disasters of India and Lessons Learnt, Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national),Non-Government and Inter-Governmental Agencies

15 Hours

UNIT – III

Applications of Science and Technology for Disaster Management: Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non Structural Mitigation of Disasters S&T Institutions for Disaster Management in India

Case Studies: Study of Recent Disasters (at local, state and national level)

Preparation of Disaster Risk Management Plan of an Area or Sector,

Role of Engineers in Disaster Management

Course Outcomes:

After completion of this course the students will be able to

1. **Explain** Concepts, Types, Trends, Causes of Disasters
2. **Describe** Consequences and Control of Disasters
3. **Explain** Disaster Management Cycle and Framework:
4. **Explain** the lesson learnt from the disasters in India and **discuss** the financial mechanism, roles and responsibilities of Non-Government and Inter-Governmental Agencies for Disaster management
5. **Describe** the Applications of Science and Technology recent disasters, role of engineers for Disaster Management and **prepare** a report of Disaster Risk Management Plan.

Mapping of POs & COs:

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

Note:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

REFERENCE BOOKS:

1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. https://nidm.gov.in/PDF/pubs/DM%20in%20India.pdf, Disaster Management in India, MHA, 2011.
3. World Disasters Report, 2018. International Federation of Red Cross and Red Crescent, Switzerland
4. Encyclopedia of disaster management, Vol I, II and III Disaster management policy and administration, S L Goyal, Deep & Deep, New Delhi, 2006
5. Encyclopedia of Disasters – Environmental Catastrophes and Human Tragedies, Vol. 1 & 2, Angus M. Gunn, Greenwood Press, 2008
6. Disasters in India Studies of grim reality, AnuKapur& others, 2005, 283 pages, Rawat Publishers, Jaipur.
7. Management of Natural Disasters in developing countries, H.N. Srivastava & G.D. Gupta, Daya Publishers, Delhi, 2006, 201 pages
8. Natural Disasters, David Alexander, Kluwer Academic London, 1999, 632 pages
9. Disaster Management Act 2005, Publisher by Govt. of India
10. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management, https://ndma.gov.in/en/publications.html#
11. NIDM Publications https://nidm.gov.in/books.asp
12. High Power Committee Report, 2001, J.C. Pant
13. Disaster Mitigation in Asia & Pacific, Asian Development Bank
14. National Disaster Management Policy, 2009, GoI
15. Disaster Preparedness Kit, 2017, American Red Cross,http://pchs.psd202.org/documents/mopsal/1539703875.pdf.
16. Subramanian R., "Disaster Management", 2018 Vikas Publishing House Pvt Ltd.

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

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INTRODUCTION TO YOGA

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 2016.
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 (2016).
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→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													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	**20HU8X71**	**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→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	PSO↓ 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:

i. A. K. Uppal, "Physical Education and Health"
ii. M. L. Kamlesh, "Fundamental Elements of physical Education",
iii. Swami Ramdev, "Yog its philosophy and practice", Divya Prakashan
iv. 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 14-20) 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 (120) characters.

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

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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 2016 United Nations officially released Agendas for Sustainable approach environmental integrity, economic viability and a just society for present and future generations. It aims to provide the knowledge, skills, attitudes and values necessary to address sustainable development challenges. They address the global challenges we face, including poverty, inequality, climate change, environmental degradation, peace and justice. Learn more and take action. This SDG program is organized in such a way to be research-led, applied interdisciplinary program that considers sustainability in both developed and developing societies, and addresses critical global challenges put forth by UN.

UNIT – I

The origin, development and idea of the SDGs

History and origins of the Sustainable Development Goals. What are the SDGs? What are their aims, methodology and perspectives? How are they related to the Millennium Development Goals?

SDGs and Society: Ensuring resilience and primary needs in society

In-depth discussion and analysis of goals related to poverty, hunger, health & well-being and education

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, 2015
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, 2008.
3. Dalby, Simon, et al. Achieving the Sustainable Development Goals: Global Governance Challenges. Routledge, 2019.
4. Sustainability: A Comprehensive Foundation by Tom Thesis and JonathanTomkin, Editors.

REFERENCE BOOKS:

1. Elliott, Jennifer. An introduction to sustainable development. Routledge, 2012.
2. Day, G.S., and P.J.H. Schoemaker (2011), 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 **20** marks each in the question paper divided into **3 Units** as per the syllabi &contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I**&**Unit – II** and **1** full question from **Unit – III**.

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INTERNET OF THINGS – (IoT)			
Course Code	**21CS8X80**	**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 the IoT Definitions, Design aspects
2. Identify the IoT hardware and software requirements
3. Describe IoT logical and physical design concepts
4. Implement Arduino based IoT Projects
5. Implement Raspberry Pi based IoT Projects

UNIT – I

Introduction

Introduction to IoT : Definition and characteristics, Physical design, Logical design, Enabling technologies, Levels and deployment templates, Examples: Domain specific IoTs, IoT Design and System Engineering, Discuss IoT Requirements, Hardware & Software; Study of IoT sensors, Tagging and Tracking, Embedded Products; IoT Design, (U) SIM Card Technology, IoT Connectivity and Management, IoT Security & IoT Communication.

(Text Book-1:, Chapter 1 to 4)

15 Hours

UNIT – II

Design Concepts:

IoT Logical Design:

Data types, Data structures, Control flow, Functions, Modules, Packages, File Handling, Date and time operation, Classes, Python packages of IoT, IoT Physical Design, Basic building blocks, Raspberry Pi, Linux on Raspberry Pi, Interfaces, Programming on Raspberry Pi with Python, Arduino Based IoT Project Implementation, Arduino for Project development, Internet enabled Arduino powered garage door opener, Irrigation control system, Light controller Message, controller and cloud Services

(Text Book-1: Chapter 4,5,6 ,7)

15 Hours

UNIT – III

09 Hours

Raspberry Pi based IoT Project Implementation:

Raspberry Pi for Project Development: Raspberry Pi platform, GPIO, Establishment and setting, of Raspberry Pi software, LAMP project, Home temperature, monitoring system, Webcam and Raspberry Pi camera project

(Text Book-1: Chapter 10,11,12, 13

Course Outcomes:

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

1. Acquire the fundamental knowledge of IoT Definitions, Design aspects
2. Identify the IoT hardware and software requirements
3. Design IoT logical and physical architecture
4. Implement Arduino based IoT Projects
5. Implement Raspberry Pi based IoT Projects

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	3	1						1	1			1		3	
CO2	2	3						1	1			1		3	
CO3	3	1						1	1			1		3	
CO4	3	2			3			1	1			1	1	3	3
CO5	3	2			3			1	1			1	1	3	3

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

TEXTBOOKS:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-On Approach,Vijay Madisetti", 2014.
2. Donald Norris, "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black", 1st Edition, McGraw Hill, 2015.

REFERENCE BOOKS:

1. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
2. Pethuru Raj and Anupama C. Raman,"The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
3. Jeeva Jose," Internet of Things", Khanna Publishing House, Delhi
4. Adrian McEwen," Designing the Internet of Things", Wiley
5. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill
6. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media

E-Books / Online Resources:

1. Object-Oriented Analysis and Design with Applications, Grady Booch, Robert A. Maksimchuk, Michael W. Engel, Bobbi J. Young, Jim Conallen, Kelli A. Houston, Third Edition The Addison-Wesley Object Technology Series, 2007
2. Object-Oriented Modelling and Design with UML, James R Rumbaugh, Michael R. Blaha Pearson Education, 21-Nov-2011
3. Object-Oriented Analysis and Design, Ramnath, Sarnath, Dathan, Brahma, ISBN 978-1-84996-522-4,, Springer Publications, 2011.

MOOC:

1. https://www.coursera.org/specializations/internet-of-things
2. https://www.udemy.com/course/iot-internet-of-things-automation-using- raspberry-pi/
3. https://www.udemy.com/course/arduino-iot-cloud/

SEE SCHEME:

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

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SOFTWARE ENGINEERING PRACTICES			
Course Code	**21IS8X83**	**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:

1. Outline software engineering principles and activities involved in building large software programs.
2. Explain the importance of architectural decisions in designing the software.
3. Describe the process of Agile project development.
4. Recognize the importance of software testing and describe the intricacies involved in software evolution.
5. Identify several project planning and estimation techniques and explain the importance of software quality.

UNIT – I

Introduction: Need for Software Engineering, Professional Software Development, Software Engineering Ethics, Case Studies.
Software Processes: Models: Waterfall Model, Incremental Model and Spiral Model; Process activities.
Requirements Engineering: Functional and non-functional requirements, Requirements engineering processes, Requirements Elicitation and Analysis, Requirements specification, Software requirements document, Requirements validation & management.

15 Hours

UNIT – II

System Models: Context models, Interaction models, Structural models, Behavioral models.

T Architectural Design: Architectural design decisions. Architectural Views and patterns, Application architectures.

Design and implementation: Object oriented Design using UML.

Agile Software Development: Agile methods, Plan-driven and agile development, Extreme Programming, Agile project management.

15 Hours

UNIT – III

Project Management: Risk management, Teamwork.

Project Planning: Software pricing, Plan-driven development, Project Scheduling

Quality Management: Software quality, Reviews and inspections, Software measurement and metrics, Software standards.

9 Hours

Course Outcomes:

Students will be able to:

Sl. No.	Course Outcomes
1.	Recognise the basics of software system, component, process and Software Requirement Specification to meet desired needs within realistic constraints and outline the professional and ethical responsibility
2.	Describe the waterfall, incremental and iterative models and architectural design in implementing the software
3.	Make use of the techniques, skills, modern engineering design tools and agile methods necessary for engineering practice.
4.	Describe the methods for maintaining software system.
5.	Discuss project planning and management and illustrate the quality of software products

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
IS2504-1.1		3	1					2					1	2
IS2504-1.2	1	3	1										1	2
IS2504-1.3	1	1	3										2	3
IS2504-1.4	1	3	2										1	2
IS2504-1.5	1	2	2										1	2

1: Low 2: Medium 3: High

TEXTBOOK:

1. Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education, 2012. 82Syllabus of III & IV Semester B.E. / Computer Science &Engg.

REFERENCE BOOKS:

1. Roger S. Pressman: "Software Engineering-A Practitioners approach", 7th Edition,Tata McGraw Hill, 2017.
2. Pankaj Jalote: "An Integrated Approach to Software Engineering", Wiley, India, 2010.

E-RESOURCES

1. http://agilemanifesto.org/
2. http://www.jamesshore.com/Agile-Book/
3. https://www.mooc-list.com/course/uml-class-diagrams-software-engineering-edx
4. https://www.mooc-list.com/course/enterprise-software-lifecycle-management-edx

SEE Question Paper Pattern:

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**fullquestions from **Unit-I & Unit – II** and **1**fullquestion from **Unit– III.**

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INTRODUCTION TO CYBER SECURITY			
Course Code	**21IS8X84**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students:

1. Define the area of cybercrime and forensics.
2. Explain the motive and causes for cybercrime, detection and handling.
3. Investigate Areas affected by cybercrime.
4. Illustrate tools used in cyber forensic

UNIT – I

Introduction to Cybercrime: Cybercrime- Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cyber Crimes. **[T1: 1.1-1.5]**

Cyberoffenses: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing. **[T1: 2.1-2.8].**

Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops. **[T1:3.1-3.12]**

14 Hours

UNIT – II

Tools and methods used in Cybercrime:
Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan-horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. **[T1: 4.1-4.12]**

Phishing and Identity Theft Introduction to Phishing, Identity Theft (ID Theft). **[T1: 5.1-5.3]**

12 Hours

UNIT – III

UNDERSTANDING COMPUTER FORENSICS

Introduction, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics. **[T1: 7.1-7.19]**

13 Hours

Course Outcomes:

Students will be able to:

Sl. No.	Course Outcome
IS2503.1	Comprehend the Cybercrime and its origin
IS2503.2	Analyse the cybercrimes in mobile and wireless devices
IS2503.3	Apply tools and methods used in Cyber crimes
IS2503.4	Analyse Phishing and and ID Theft
IS2503.5	Comprehend Digital Forensics

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
IS2503-1.1	2					1		3						
IS2503-1.2		3		1		2			2					
IS2503-1.3		3	2										2	3
IS2503-1.4	2					2								
IS2503-1.5								3						

(L/1 = Low 30%-49%, M/2 = Medium 50%-69%, H/3=High >70%)

TEXTBOOKS:

1. SunitBelapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81-265-21791, Publish Date 2013.

REFERENCE BOOKS:

1. Thomas J. Mowbray, "Cyber security: Managing Systems, Conducting Testing, and Investigating Intrusions", Copyright © 2014 by John Wiley & Sons, Inc, ISBN: 978 -1-118 -84965 -1.
2. James Graham, Ryan Olson, Rick Howard, "Cyber Security Essentials", CRC Press, 15-Dec 2010. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw-Hill.

SEE Question Paper Pattern:

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**fullquestions from **Unit-I & Unit – II** and **1**fullquestion from **Unit– III.**

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SPACETECHNOLOGYANDAPPLICATIONS			
Course Code	**21EC8X85**	**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 the general laws governing satellite orbits and its parameters.
2. Discuss effect of space environment on satellite signal propagation.
3. Illustrate various segments employed in satellite and ground station.
4. Calculate the uplink/downlink sub system characteristics.
5. Know the effects on the EM waves in propagation through space.
6. Explain the satellite launch in the space and their applications in remote sensing.
7. Discussthethedifferentcommunicationsystemsusedforsatelliteaccess.
8. Summarise Advanced space systems for mobile communication, VSAT, GPS.

UNIT – I

Satellite communications: Introduction, Kepler's laws, definitions, orbital element, apogeeandperigeeheights, orbit perturbations, inclined orbits.

Space environment: Earth's Atmosphere, Ionosphere and Meteorological effects on space systems, propagation of signal, Transmission losses in space environment.

Satellite Technology: Space segment, Ground segment, Quality and Reliability, Satellite Communication systems, Antennas.

15 Hours

UNIT – II

LaunchVehicles: Working,stages,Fuel,payloadprotection,Navigation,guidanceandcontrol,Reliability,launchingi ntoouter space and launch bases. Types of launch vehicles.

Space Applications: Digital DBS TV, DBS-TV System Design, Master Control Station and Uplink Antennas. Introduction, Radio and Satellite Navigation,

Remote Sensing: Introduction to Remote Sensing, Concepts and Applications of satellite Remote sensing.

14 Hours

UNIT – III

Satellite Access: Introduction, Single Access, Pre-assigned FDMA, Demand-Assigned FDMA, Spade system.

Advancedspacesystems: Satellitemobileservices,VSAT,Radarsat,orbitalcommunication**.**GlobalPositioning Satellite System (GPS).

10 Hours

Course Outcomes:

At the end of the course student will be able to

1. Discuss the fundamental principles of Satellite communication systems.
2. Discuss the Propagation impairments of satellite link.
3. Explain various segments employed in satellite and ground station.
4. Discuss the satellite launch mechanism and roll of those satellite in remote sensing.
5. Explain the different communication systems used for satellite access and list the recent satellites that have been launched for mobile communication, GPS.

Course Outcomes:

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

High Assessment Details (both CIE and SEE)

TheweightageofContinuousInternalEvaluation(CIE)is50%andforSemesterEndExam(SEE)is50%.The student must obtain minimum of 20 marks out of 50 in CIE and 20 marks out of 50 in SEE and 40%intotaltoobtainapassgrade.Semester End Exam(SEE)is conducted for 100 marks (3Hoursduration). Based on this grading will be awarded.

Continuous Internal Evaluation:

1. **Methods recommended:** Two Tests (80%), Written Quiz (16%) and module assignments (4%).Course coordinator will announce the evaluation procedure at the beginning of the semester and will be recorded in the course plan.

Semester End Examination:

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

TEXTBOOKS:

T1. Dennis Roddy, **"Satellite Communications"**, McGraw Hill 1996.
T2.TimothyPratt,**"SatelliteCommunications"**,WileyIndiaLtd,2006.
T3.KRamamurthy,**"RocketPropulsion"**,McMillanPublishersIndiaLtd,2010.

REFERENCE BOOKS:

R1. George Joseph, **"Fundamentals of Remote Sensing"**, Universities press, India 2003.
R2.BC Pande, **"Remote sensing and Applications"**, VIVA Books pvtltd, 2009.
R3. Meynart Roland, **"Sensors systems and next generation satellites"**, SPIE Publication.
R4.Thyagarajan ,**"Space Environment"**, ISRO Hand Book Publication.

E-Books / MOOC:

https://nptel.ac.in/courses/101106046

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

Course Outcomes (CO):

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

CO1	Explain the basic marketing concepts
CO2	Interpret the buying behaviour of customers and role of marketing segments
CO3	Explain the role of product pricing and marketing research in the competitiveglobal business environment
CO4	Analyse the marketing plans and strategies.
CO5	Explain the role of sales, advertising and distribution in marketing to achieve the goals ofmarketing

TEXTBOOK:

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

REFERENCE BOOKS:

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

NEXT GENERATION WIRELESS NETWORKS

Course Code	**21CC8X94**	**CIE Marks**	50
Number of Contact Hours/Week	**3:0:0**	**SEE Marks**	50
Total Number of Contact Hours	**39**	**Exam Hours**	03

Credits – 3

UNIT - I	**Contact Hours**
Historical Trend for Wireless Communication- Mobile Communications Generations: 1G to 4G – Evolution of LTE Technology to Beyond 4G – Pillars of 5G – Standardization Activities -Use cases and Requirements – System Concept **5G Architecture**: Software Defined Networking – Network Function Virtualization – Basics about RAN Architecture –High-Level Requirements for 5G Architecture – Functional Architecture and 5G Flexibility – Physical Architecture and 5G Deployment.	15
UNIT - II	
Massive Multiple-Input Multiple –Output Systems : MIMO in LTE – Single-user MIMO – Multi-user MIMO – Capacity of Massive MIMO – Pilot Design of Massive MIMO. **D2DCommunications**: from4Gto5G–Radio Resource Management for Mobile Broadband D2D–Multi-hop D2D Communications for Proximity and Emergency Services – Multi-operator D2D Communication.	15
UNIT – III	
Wi-Fi 6 Protocol and Network: Introduction Wi-Fi Generations 1 to 5 Overview Wi-Fi Generation 6 (802.11ax) Wi-Fi6 and 5G 60 GHz Wi-Fi , Introduction to 6G and Networks	9
<u>Course Outcomes:</u> Upon completion of this course, students will be able to: 1.Describe and explain the evolution of 5G, system concepts and spectrum challenges 2.Illustrate and explain the 5G functional and physical architecture and its requirements 3 Illustrate and explain the fundamentals, resource allocation and transceiver algorithms for Massive MIMO 4.Describe and explain the requirements and fundamental techniques for D2DCommunication 5. Understand, Implement, explain the Wi-Fi 6 Protocol and Network	
TEXTBOOKS: • Asif Oseiran, JoseF. Monserratand Patrick Marsch, "5GMobile and Wireless Communications Technology,"Cambridge University Press,2016 • Jonathan Rodriquez, "Fundamentalsof5GMobileNetworks," Wiley, 2015 Sundar Gandhi Sankaran, Susinder Rajan Gulasekaran, **Wi-Fi 6 Protocol and Network, Artech House, 2021**	
REFERENCE BOOK: • Patrick Marsch, Omer Bulakci, Olav Queseth and Mauro Boldi, "5G System Design – Architectural and Functional Considerations and Long Term Research", Wiley, 2018	

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INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Code	**21AI8X95**	**CIE Marks**	**50**
Number of Contact Hours/Week	**3:0:0**	**SEE Marks**	**50**
Total Number of Contact Hours	**40**	**Exam Hours**	**03**

Credits – 3

Course Learning Objectives:

This Course will enable students to:

1. Understand the history of AI and machine learning.
2. Learn principles and algorithms of supervised learning.
3. Explain various applications of Techniques in association analysis.
4. Use different unsupervised learning techniques to solve the problem specification.
5. Understand the methods of parametric and non-parametric methods on real time data analysis and combined learners.

UNIT – I	**Hours**
Introduction to AI: what is AI, Acting Humanly: The Turing Test approach, Thinking Humanly: The cognitive modelling approach, thinking rationally: The laws of thought approach, Acting Rationally: The rational agent approach. The state of art **Branches Of Artificial Intelligence:** Machine Learning, Deep Learning, Natural Language Processing, Robotics, Expert Systems, Fuzzy Logic. **Intelligent Agents:** Agents and Environments, Good behavior: The concept of rationality, The nature of environments, properties of task environments, Structure of Agents: Agent Programs, Types of agent programs. **Solving Problems by Searching:** Problem solving Agents, well defined problems and solutions, formulating problems, Example problems: Toy problems: Vacuum world, 8-Queen's problem, Real world problem: Airline Route finding problem **Textbook 1: Chapter 1, 2 ,3** **Foundations of Machine Learning** What is machine learning? Applications of Machine learning, Understand Data. **Types of machine learning:** Supervised, Unsupervised, Reinforcement Learning. **Supervised Learning:** Linear Regression: Introduction, univariate linear regression, multivariate linear regression, regularized regression, Logistic regression, Support Vector Machines. Artificial Neural Networks. **Textbook: Chapter 1 , 2.** **Classification:** Preliminaries; General approach to solving a classification problem; Confusion Matrix, Decision tree induction, how decision tree works, Hunt's algorithm, Design issues, Methods for expressing attribute test conditions, Measures for selecting best fit, Algorithm for decision tree induction; Rule-based classifier: How rule-based classifier works, Rule ordering schemes, Nearest-neighbor classifier: Selecting K value, KNN algorithm. **Textbook 3: Chapter 4, 5** Tutorials: 1. Handling the missing values using orange tool. 2. Visualize: Scatter Plot (for univariate), Scatter Plot Matrix (for multivariate) using orange tool. **3.** iris classification using different algorithm.	15

UNIT - II	
Unsupervised Learning: **Association Analysis–1:** Problem definition, Frequent item set generation, Apriori principle, Candidate generation and pruning, Rule Generation in Apriori algorithm. **Association Analysis – 2:** FP-Growth algorithm, Evaluation of association patterns, Effect of skewed support distribution, Sequential patterns. **Cluster Analysis:** Different types of clustering: Hierarchical vs partitional, Exclusive vs overlapping, Fuzzy clustering, Complete vs partial. Types of clusters: Well separated, Prototype based clusters, Graph based clusters, Density based clusters, Conceptual clusters, K-means clustering algorithm, centroids and objective functions, Choosing initial centroids, time space complexity of K-means, K-means additional issues, Strengths and weakness of k-means, Agglomerative hierarchical clustering,	15

Key issues in hierarchical clustering, Strengths and weaknesses, DBSCAN algorithm. **Textbook 3: Chapter 6, 7, 8, 9.** Tutorials: 1. Diabetes classification using orange tool. 2. Association analysis using orange tool. **3.** Trying different evaluation matrix using orange tool.	
UNIT – III	
Parametric Methods: Introduction, Maximum Likelihood Estimation, Bernoulli Density, Multinomial Density, Gaussian (Normal) Density, Evaluating an Estimator: Bias and Variance, The Bayes' Estimator, Parametric Classification **Nonparametric Methods**: Introduction, Nonparametric Density Estimation, Histogram Estimator, Kernel Estimator, k-Nearest Neighbor Estimator, Generalization to Multivariate Data, Nonparametric Classification, Condensed Nearest Neighbor. **Textbook 2: Chapter 4, 8.**	10
Course Outcomes: Upon completion of this course, students will be able to: 1. Basics of AI, branches of AI and ML. 2. Develop an appreciation for what is involved in learning models from supervised learning and algorithms on classification. 3. Apply association analysis on structured data. 4. Apply different unsupervised learning techniques to solve the problem specification. 5. Interpret methods of parametric and non-parametric methods on real time data analysis and know the combined learning.	
TEXTBOOKS: 1. Stuart Russel and Peter Norvig, "Artificial Intelligence A Modern Approach", Pearson 3rd Edition, 2016. 2. Introduction to Data Mining-Pang-NingTan, Michael Steinbach,Vipin Kumar, Pearson Education, 2009. 3. Ethem Alpaydin, Introduction to Machine Learning, Second Edition, 2004.	
REFERENCE BOOKS: 1. T. M. Mitchell, "Machine Learning", McGraw Hill, 1997. 2. R. O. Duda, P. E. Hart and D. G. Stork Pattern Classification, Wiley Publications, 2001 3. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2008. 4. P. Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012. 5. K. P. Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012. 6. M. Mohri, A. Rostamizadeh, and A. Talwalkar, "Foundations of Machine Learning", MIT Press, 2012. 7. S. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Prentice Hall, 2009.	

MICRO AERIAL VEHICLES

Course Code	**21RI8X91**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**(3:0:0:0)**	**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, Definitions and Terminology, **Classification of UAV's,** Classes and Missions of UAVs, 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

9 Hours

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	
MSE I	20 Marks
MSE II	20 Marks
Task-I	5 Marks
Task-II	5 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 : / Micro Aerial Vehicles															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2

1: 1ow 2: Medium 3: High

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SUSTAINABILITY ENGINEERING

Course Code:	**21CV8X96**	**CourseType:**	**OE**
Teaching Hours/Week (L:T:P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**39**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Civil Engineering

Course Objectives: This Course will enable students to:

1.	Understand the relevance, the concept and the role of engineers in sustainable development
2.	Understand green building concepts, materials, certifications, and sustainable practices through case studies in sustainability engineering.
3.	Master Life Cycle Assessment principles for environmental, social, and economic analysis in engineering applications.

4.	Enable students to understand and apply sustainability reporting frameworks like GRI, Dow Jones, and prepare comprehensive sustainability reports.
5.	Develop skills to integrate sustainability principles into civil engineering design processes, employing sustainable strategies and measuring sustainability effectively.

UNIT - I

Sustainable Development

Sustainable development- Need- various agreements and Role of Engineering- Sustainable Development and Engineering Profession. Sustainable Engineering concepts, Goals of Sustainability, System Thinking, Life cycle Thinking and circular economy

Green Building: Concept, green building materials, green building certification and rating: green rating for integrated habitat assessment (GRIHA) , leadership in energy and environmental design (LEED) rating, energy efficient buildings, sustainable cities, sustainable transport, sustainable pavements, case studies in sustainability engineering: Green building, sustainable city, sustainable transport system

15 Hours

UNIT - II

Fundamentals of Life Cycle Assessment

Energy systems, Buildings and the Built Environment, Life cycle inventory, Life Cycle Impact Assessment, Interpretation and presentation of Results, Iterative Nature of LCA, Methodological Choices, LCI Databases and LCA Softwares, Strength and Limitations of LCA. Environmental Life Cycle Costing, Social Life Cycle Assessment, Life Cycle Sustainability, **LCA Applications in Engineering:** Environmental Product Declarations and Product Category Rules, Carbon and Water Foot Printing,

Sustainability Reporting: GRI, Dow Jones Sustainability Index, Analysis and Research; Prerequisites of a sustainability Report, structure of a sustainability Report, Case Study: Sustainability Report Preparation.

15 Hours

UNIT - III

Integrating Sustainability in Civil Engineering Design:

Integrating Sustainability in Engineering Design: Problems Solving in Engineering, conventional to Sustainable Engineering Design Process, Design for Life Guidelines and Strategies, Measuring Sustainability, Sustainable Design through sustainable procurement criteria, Case studies on sustainable Engineering Design Process – Sustainable Process Design, Sustainable construction planning and Design, sustainable materials design in Civil Engineering.

09 Hours

Course Outcomes: At the end of the course students will

1.	Be proficient in applying sustainable engineering concepts, integrating system and life cycle thinking to address global challenges in the engineering profession.
2.	Adeptly apply green building principles, materials, certifications, and sustainability engineering case studies to contribute effectively to sustainable urban development.
3.	Master Life Cycle Assessment principles for comprehensive engineering analysis, integrating environmental, social, and economic dimensions effectively.
4.	skillfully prepare sustainability reports using GRI standards and Dow Jones Sustainability Index, applying theoretical knowledge to practical case studies for effective reporting.
5.	Adeptly integrate sustainability principles into civil engineering design, applying life cycle strategies and sustainable procurement criteria through case studies analysis.

Course Outcomes Mapping with Program Outcomes & PSO

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

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Sreenivasan Sundarrajan, (2018). "Sustainable Development: Principles, Frameworks, and Practices", Springer
2.	S. S. Bhavikatti , (2016). "Sustainable Engineering: Concepts and Applications" Publisher: I.K. International Publishing House Pvt. Ltd.

3.	Gaurav Biswas, (2019). " Engineering Sustainable Communities: Principles and Practices ", CRC Press
4.	"Green Buildings Pay" by Brian W. Edwards (2013, TERI Press)
5.	"Handbook of Green Building Design and Construction: LEED, BREEAM, and Green Globes" by Sam Kubba (2017, Butterworth-Heinemann)
6.	"Life Cycle Assessment: Theory and Practice" Bhupendra Kumar Sharma 2017 TERI Press
7.	"Life Cycle Assessment: Principles, Practice and Prospects" Author: R. K. Goel Publisher: TERI Press Year of Publication: 2017
8.	"Sustainability Reporting: GRI, Dow Jones Sustainability Index, Analysis and Research" Author: Zabihollah Rezaee Publishing Year: 2017 Publisher: John Wiley & Sons
9.	"Sustainable Engineering: Concepts, Design and Case Studies" by David T. Allen, 2019, Wiley.
E Books / MOOCs/ NPTEL	
1.	https://onlinecourses.nptel.ac.in/noc24_de01/preview; Strategies for Sustainable Design.
2.	https://onlinecourses.nptel.ac.in/noc24_hs77/preview; Energy Resources, Economics, and Sustainability;