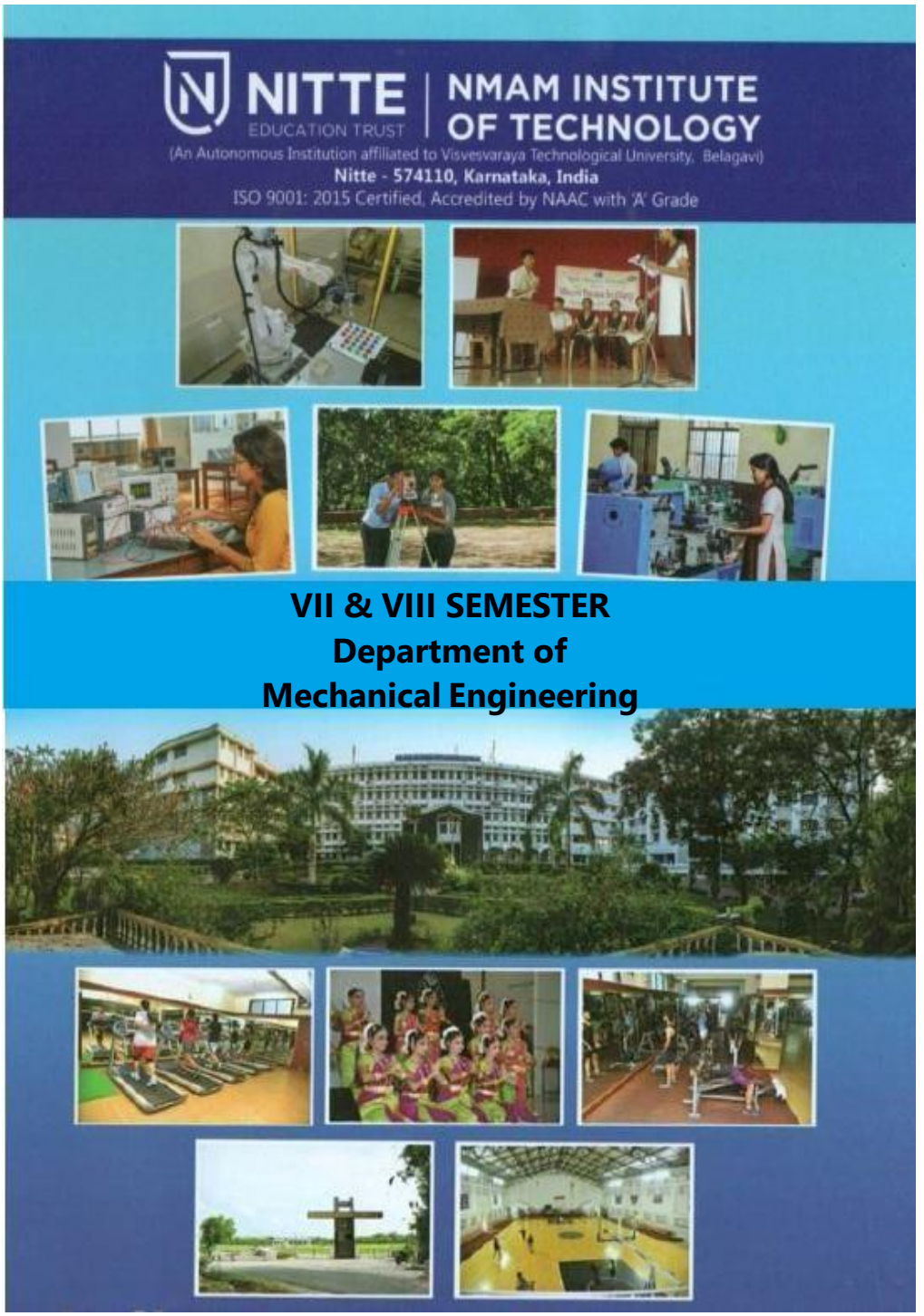
NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

College Calendar 2023-24

Department of Mechanical Engineering

Syllabus of 4th Year



College Calendar 2023-24

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

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

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

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

NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

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

COLLEGE CALENDAR
2023-24
(VII & VIII Semester)

NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

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NITTE-574110, Karkala Taluk, Udupi District, Karnataka, India
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Vision Statement

Pursuing Excellence, Empowering people, Partnering in Community Development

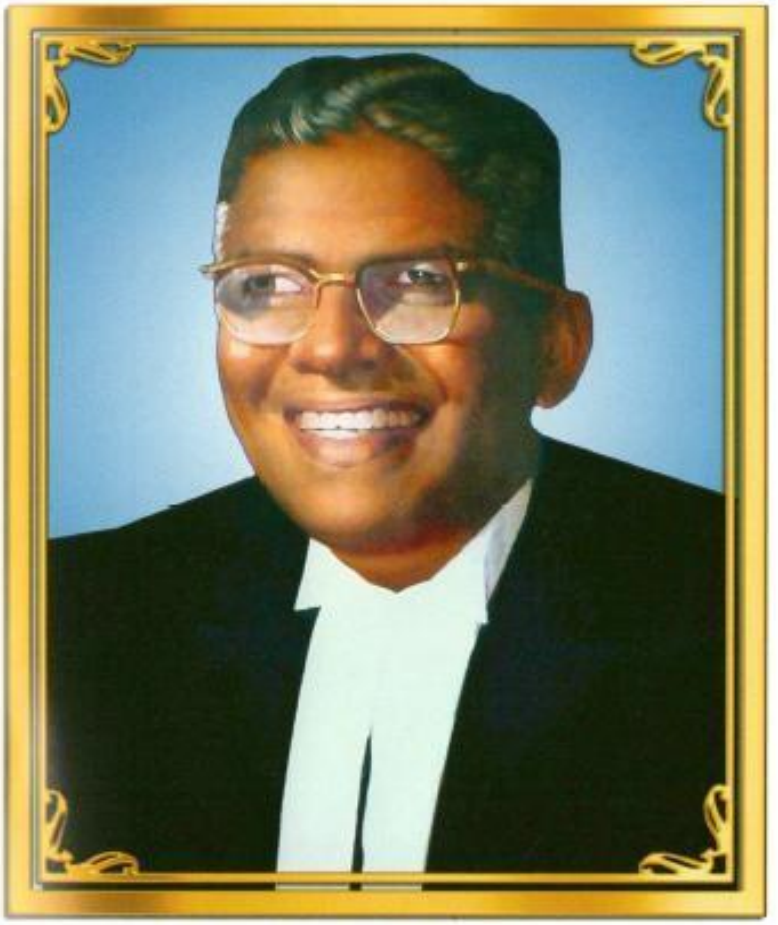
Mission Statement

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

In Memorium

Late Nitte Mahalinga Adyanthaya

Our Founder



Late Justice K. S. Hegde

1909-1990

SRI N. VINAYA HEGDE

President, Nitte Education Trust
Chancellor, Nitte (Deemed to be University), Mangaluru

NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

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

HEADS OF DEPARTMENTS

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

16.	Dr. Venugopala PS	HoD, Artificial Intelligence & Data Science
17.	Mr. Bharath G Kumar	Head, Training & Placement Cell

INCHARGE OF INSTITUTION'S RESPONSIBILITIES

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

ENTREPRENEURSHIP DEVELOPMENT CELL

1.	Dr. Ramakrishna B	Professor/EDC- Incharge
2.	Mrs. Geetha Poojarthi	Co-ordinator

DEPARTMENT OF TRAINING & PLACEMENT

1.	Mr. Ankith S Kumar	Counsellor

DEPARTMENT OF MATHEMATICS

1.	Dr. Shashirekha B. Rai	Professor
2.	Dr. Kumudakshi	Asso. Professor/ HoD
3.	Dr. Sharad M. Hegde	Asst. Professor Gd III
4.	Dr. Vasanth K.R	Asst. Professor Gd III
5.	Dr. Ashwini Kumari	Asst. Professor Gd III
6.	Dr. Chaithra K.	Asst. Professor Gd III
7.	Dr. Prashanthi K S	Asst. Professor Gd III
8.	Dr. Girija K P	Asst. Professor Gd III
9.	Dr. Ganesh Kumar K	Asst. Professor Gd III
10.	Mrs. Ambika N.	Asst. Professor Gd I
11.	Mrs. Vinaya Acharya	Asst. Professor Gd I
12.	Mrs. Anitha D. Bayar	Asst. Professor

13.	Mrs. Bhavya K.	Asst. Professor
14.	Mrs. Bhavya. D.	Asst. Professor
15.	Mrs. Sharmila	Asst. Professor
16.	Mrs. Anjana Pai K	Asst. Professor
17.	Mrs. Soumya	Asst. Professor
18.	Mrs. Smitha G. V.	Asst. Professor

DEPARTMENT OF PHYSICS

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

DEPARTMENT OF CHEMISTRY

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

DEPARTMENT OF HUMANITIES

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

11.	Mrs. Shwetha	Asst. Professor

OFFICE SECTION HEADS

1.	Mr. Keshava Mugeraya	Sr. Suptd, Academic Section/ Purchase In -Charge
2.	Mrs. Suneetha R. Shetty	Sr. Suptd, Administrative Section
3.	Mr. Suresh Achar	Sr. Suptd, Stores
4.	Mrs. Jayashree	Sr. Programmer, Office Automation Cell
5.	Mrs. Shailaja V. Shetty	Suptd, Accounts Section
6.	Dr. Preetham Shetty KV	Librarian

SECURITY DEPARTMENT

1.	Mr. Hirianna Suvarna S	Security Supervisor

SPORTS DEPARTMENT

1.	Sri. Shyam Sundar M.	P.E.D
2.	Sri. Ganesh Poojary	P.E.D
3.	Ms. Sowjanya M.	P.E.I
4.	Mr. Ravi Prakash C. Anpur	Basket Ball Coach
5.	Mr. Clive Nolan Mascarenhas	Football Coach
6.	Mr. Rajesh Acharya	Cricket Coach

HOSTEL WARDENS

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

HOSTEL SUPERINTENDENT / MANAGER

1.	Mr. John D'Souza	Sr. Manager, Gents Main Hostel
2.	Mr. Manjunatha Suvarna	Hostel Manager, Gents Main Hostel
3.	Mr. Rajesh Ballal	Manager, Gents PG Hostel
4.	Mrs. Gayathri Kamath	Manager, Ladies PG Hostel
5.	Mrs. Chethana Sharma	Manager, Ladies Main Hostel
6.	Mrs. Hema S. Hegde	Superintendent, Hostel Office

REGULATIONS

2022-23

(Applicable for admission batch 2018-20 onwards)

NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

CONTENTS

REGULATIONS

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 20 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 (20) 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

Typical Course Load per Semester			
No. of Courses	**Credits / Course**	**Total Credits**	**Contact Hours per Week**
2 Lecture Courses	3:0:0	6	6
2 Lec. cum Lab Courses	3:0:1	8	10
2 Lec. cum Tut. Courses	3:1:0	8	10
1 Lec. Tut. cum Lab Courses	1:1:1	3	5
Total	**10:2:2**	**25**	**31**

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

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

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

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

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 (=22) or to be within the limits of minimum (=16) and maximum (=28) credits.

4.2 **DROP-option**

During a specified period at the middle of a semester student's performance in CIE is reviewed by the faculty advisor. Following poor performance by a student he/she can be facilitated to drop identified course(s) (up to the minimum credits specified for the semester). Such course(s) will not be mentioned in the Grade card. Such courses to be re-registered by these students and taken up for study at a later time.

4.3 **Withdrawal from courses**

During a specific period specified towards the end of the semester, student's performance in CIE is reviewed by the Faculty advisors. Following poor performance by a student in identified course (s) he/she is advised to withdraw from such course(s) (up to the minimum credits specified for the semester) with mention in the Grade card (Grade ‗W'). Such courses to be re-registered by these students and taken up for study at a later time.

4.4 **AUDIT-option**

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

5. **COURSE STRUCTURE:**

5.1 Typical Breakdown for the B.E. Degree Curriculum:

No.	Course Category	Credit Range
1.	Basic Sciences (BSC)	24-30
2.	Engineering Sciences (ESC)	15 -20
3.	Humanities, Social Sciences and Management	7- 10
4.	Professional Courses (PCC) – core	70 - 90
5.	Professional Courses (PEC) – elective	18
6.	Open Elective Courses (OE)	06
7.	Project Work (PROJ) Seminar on Current Topic	16 (VI – 2, VII-2, VIII-12) 01
8.	Internship	03
9.	Mandatory Learning courses	Non-Credit
Note: **Student can register between 16 to 28 credits per semester** **Total Credits to be earned : 175**		

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

5.3 **The earned Credit Requirement for the B.E. Degree is 175.**

Degree is awarded by prescribing the total number of credits to be earned, rather than by using the program duration, giving flexibility to student to plan their career.

5.4 **Mandatory Learning Courses**

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

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

Courses that come under this category are the following.

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

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

5.5 **PROJECT**

i) Project work at 8^{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 5^{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 5^{th}, 6^{th}, 7^{th} and 8^{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 (175 credits) within the time limits specified by the university.

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

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

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

7.2 Permanent Withdrawal

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

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

(a) A student who wants to leave the College for good, will be permitted to do so (and take Transfer Certificate from the College, if needed), only

after remitting the Tuition fees as applicable for all the remaining semesters and clearing all other dues if any.

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

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

8. EVALUATION SYSTEM

8.1 The Academic Performance Evaluation of a student shall be according to a Letter Grading System, based on the Class Performance Distribution.

8.2 The Letter grades S, A, B, C, D, E, F indicate the level of academic achievement, assessed on a decimal (0-10) scale.

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

Semester End Examination (SEE) : 50% (50 marks)

Continuous Internal Evaluation (CIE) : 50% (50 marks)

i) Quizzes, Tutorials, Assignments, Seminars, mini projects, tutorials etc. : 10 marks

ii) Mid-semester Examination : 40 marks

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

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

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

8.6 **Passing standards**

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

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

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

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

However, students

- who have abstained from attending CIE or SEE without valid reasons (‗N' grade), or
- who have failed (‗F' grade) to meet the minimum passing standards prescribed for CIE and/or SEE, or
- who have been detained for want of attendance, or
- who have withdrawn (‗W' grade),
- who have dropped any course

shall be required to re-register for such course(s) and go through CIE and SEE again and obtain a grade equal to or better than E in each case. While such students should re-register for same course(s) if core, they can re-register for alternative course(s) from among the elective courses, as the case may be. The re- registration shall be possible when the particular course is offered again either in a main (Odd/Even) or a supplementary semester.

8.7 **i) Grade point scale for absolute grading**

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

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

8.8 **Earning of Credits**

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

8.9 The Transitional Grades _I', _W' and _X' would be awarded by the teachers in the following cases. These would be converted into one or the other of the letter grades (S-F) after the student completes the course requirements.

- Grade _I': To a student having satisfactory attendance at classes and meeting the passing standard at CIE, but remained absent from SEE for valid & convincing reasons acceptable to the College, like:

i) Illness or accident, which disabled him/her from attending SEE;
ii) A calamity in the family at the time of SEE, which required the student to be away from the College;

- Students who remain absent for Semester End Examinations due to valid reasons and those who are absent due to health reasons are required to submit the necessary documents along with their request to the Controller of Examinations to write Make up Examinations within 2 working days of that particular examination for which he or she is absent, failing which they

will not be given permission. This is admissible only for students who have more than 45 CIE marks.

- Grade ‗W': To a student having satisfactory attendance at classes, but withdrawing from that course before the prescribed date in a semester under Faculty Advice
- Grade ‗X': To a student having attendance ≥85% and CIE rating (90%), in a course but SEE performance observed to be poor, which could result in a F grade in the course. **(No „F" grade awarded in this case but student"s performance record maintained separately).**

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

8.11 The Make Up Examination

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

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

have to re-register for the course in a succeeding semester and take steps to fulfill the requirements of the Degree.

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

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

9. EVALUATION OF PERFORMANCE

The overall performance of a student will be indicated by two indices:

SGPA; which is the Semester Grade Point Average, and CGPA which is the Cumulative Grade Point Average.

SGPA for a semester is computed as follows.

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

CGPA is computed as follows:

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

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, so that the CGPA, in particular, can be made use of in rank ordering the students' performance at a College. If two students

get the same CGPA, the tie could be resolved by considering the number of times a student has obtained higher SGPA; But, if it is still not resolved, the number of times a student has obtained higher grades like S,A,B etc. could be taken into account.

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

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

11.2 **A Student shall be declared fail if he / she**

(i) Has not satisfied the CIE requirements of any Course/s.

(ii) Has not registered for the SEE even after satisfying the attendance and CIE requirements.

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

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

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

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

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

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

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

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

(b.1) In case, any student fails to satisfy the attendance requirement of the Courses Additional Mathematics I and II, he/she shall not be eligible

to appear for the Semester End Examinations of that semester and shall not be permitted to take admission to next higher semester. The candidate shall be required to repeat that semester during the subsequent year.

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

(c) Completion of Additional Mathematics I and II shall be mandatory for the award of degree.

(C) Vertical Progression in case of B.Sc students admitted to Second year (Lateral entry):

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

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

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

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

(b.2) Students who have satisfied the attendance requirement but not the CIE requirements of the above said Courses, shall be permitted to register afresh and appear for SEE after satisfying the CIE requirements in the same

Course/s (with or without satisfying the attendance requirement) when offered during subsequent semester/s.

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

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

11.4 Termination from the programme

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

i) **Failure to secure a CGPA = 5.0 on three consecutive occasions.**
ii) **Failure to earn a credit of 175 (135 for lateral entry students) in 8 years (6 years for lateral entry students) of duration from the year of admission including the duration of temporary withdrawal (leave of absence).**
iii) Absence from classes for more than **six weeks at a time** in a semester without leave of absence being granted by competent authorities.
iv) Failure to meet the standards of discipline as prescribed by the college from time to time.

12. AWARD OF CLASS

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

Percentage Equivalence of Grade Points (For a 10-Point Scale)

Grade Point	Percentage of Marks
5.75	50 (second class)
6.25	55
6.75	60 (First class)
7.25	65
7.75	70 (Distinction)
8.25	75

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 (175 credits for regular students registered for 4 year degree programmes & 135 for lateral entry students).

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

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

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

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

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

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

(2) B.E. (Honors) Degree

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

These Regulations are applicable for the following students:

1. Admitted to **I semester** / I year from the academic year **2018-20** (i.e. USN XXX18XXXXX)
2. Admitted to **III semester** / II year from the academic year **2020-20** (i.e. USN XXX20XX4XX)
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 5thto 8thsemester 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 Degreell 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 outs ide 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

<table>
<tr><th>Applicable to</th><th>Types of scholarship</th><th>Method</th><th>Website</th></tr>
<tr><td rowspan="2">For SC/ST Students</td><td>Income : Below Rs.2,50,000/-</td><td rowspan="2">Online application</td><td rowspan="4">SSP</td></tr>
<tr><td>Income : Above Rs.2,50,000/- to Rs.10,00,000/-</td></tr>
<tr><td rowspan="4">For Others</td><td>Category I : Income Below Rs.2,50,000/-</td><td>Online application</td></tr>
<tr><td>Category 2A, 3A, 3B Income Below Rs.1,00,000/-</td><td>Online application</td></tr>
<tr><td>GSB & Brahmins EWS Certificate upto Rs.8,00,000/-</td><td>Online application</td></tr>
<tr><td>Minority students Income Below Rs.2,50,000/-</td><td>Online application</td><td>NSP & SSP</td></tr>
<tr><td>Parents must have Beedi Id. Card</td><td>Beedi Scholarship</td><td>Online application</td><td>scholarships.gov.in or nsp.gov.in</td></tr>
</table>

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

B. E. SYLLABUS

2023-24

MECHANICAL ENGINEERING

VII & VIII SEMESTER

With

Scheme of Teaching

& Examination

DEPARTMENT OF MECHANICAL ENGINEERING FACULTY

ADJUNCT FACULTY

Mr. S. Gopinath Former Executive Director BHEL - Trichy	**Dr. G. Ravichandran** Former General Manager Welding Research Institute, Trichy

UNDERGRADUATE PROGRAMME

Dr. Shrinivasa Rao B. R. M. Tech, PhD Professor, Vice Principal and COE IC Engines, Alternative Fuels	**Dr. Subrahmanya Bhat K.** M. Tech, PhD Professor Quality Management subrahmanyabhat@nitte.edu.in
Dr. Shashikantha Karinka M. Tech, PhD Professor IC Engines shashikanthakarinka@nitte.edu.in	**Dr. Srinivas Pai P.** M. Tech, PhD Professor & Head Tool Condition Monitoring srinivasapai@nitte.edu.in
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M. Tech. ENERGY SYSTEMS ENGINEERING	
Dr. Sudesh Bekal M. Tech, PhD Professor and Dean (R&D) IC Engines,	**Dr. Udaya D.** M. Tech, PhD Associate Professor Composite Materials, Energy Mgmt. udaya_d@nitte.edu.in
Mr. Aneesh Jose M. Tech, (PhD) Assistant Professor Gd II Energy Storage, Refrigeration aneeshjose@nitte.edu.in	

M. Tech. MACHINE DESIGN	
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Dr. Ajith M. Hebbale M. Tech, PhD Associate Professor Material Processing through Microwave Energy ajith.hebbale@nitte.edu.in	

Full-Time Research Scholars/Research Staff

Mr. Prasad Prabhu M. Tech (PhD) Research Scholar Micromachining prasadprabhu@nitte.edu.in	**Mr. Nirmith Jain** M. Tech Research Assistant
Mr. Vikas Marakini M. Tech, MS Junior Research Fellow	

DEPARTMENT OF MECHANICAL ENGINEERING

Vision Statement:

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

Mission Statement:

The Dept. of Mechanical Engineering is committed to –

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

Programme Educational Objectives (UG)

To satisfy the mission of the mechanical engineering program, the graduates will:

1. Be able to research, design, develop, test, evaluate, and implement engineering solutions to problems that are of a complexity encountered in professional practice.
2. Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments.
3. Consider the ethical implications and societal impacts of engineering solutions.
4. Continuously improve through lifelong learning.

Programme outcomes (UG):

Programme Outcomes (PO) and Programme Specific Outcomes (PSO)s for Department of Mechanical Engineering (U.G)	
PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Programme Outcomes (PO) and Programme Specific Outcomes (PSO)s for Department of Mechanical Engineering (U.G)	
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
P04	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6.	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
P09	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clearinstructions.
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO1	An ability to apply the concepts and principles of design and to develop solutions to real world problems useful to industries and society in general, which are ethically right, economically sound and environmentally sustainable.
PSO2	Understand and apply thermal engineering principles in solving problems related to the domain, to improve efficiency, reduce losses and pollution and effectively harness different forms of renewable sources of energy for the betterment of future generations.
PSO3	Understand the importance of manufacturing process and its role in industrial development and provide knowledge about the basics and advances to improve productivity.

Graduate Attributes:

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These attributes are generic and are common to all engineering programs. These Graduate Attributes are identified by National Board of Accreditation.

Sl. No.	**Graduate Attributes**
a.	Engineering Knowledge
b.	Problem Analysis
c.	Design / development of solutions
d.	Conduct investigations of complex problems
e.	Modern tool usage
f.	The engineer and society
g.	Environment and sustainability
h.	Ethics
i.	Individual and team work
j.	Communication
k.	Project management and finance
l.	Life-long learning

N.M.A.M. Institute of Technology, Nitte
Scheme of Teaching and Examination 2022-23
Choice Based Credit System (CBCS)

VII SEMESTER B.E.

Sl. No	Category	Code	Course Title	Teaching Hours / Week				Credits
				Theory /Lecture	Tutorial	Practical /Drawing	Total Contact Hours	
1	PCC	20ME701	Heat Transfer	4	*		5	4
2	PCC	20ME702	Mechatronics	3		2	5	4
3	PEC	20ME71X	Elective IV	3			3	3
4	PEC	20ME72X	Elective V	3			3	3
5	OEC	20ME7XX	Open Elective I	3			3	3
6	Laboratory	20ME703	Heat Transfer Lab			2	2	1
7	Laboratory	20ME704	Dynamics Lab			2	2	1
8	Seminar	20ME705	Technical Seminar			2	2	1
9	Project	20ME706	Project Phase - I			8	8	3
				Total			**33**	**23**

Note: PCC – Professional Core Courses**, PEC** – Professional Elective Courses, **OEC** – Open Elective Courses * 1 hour of tutorial will be conducted. ** Choice based Course. *** An Audit course on modern tool usage in manufacturing may be considered for merit/Interested students with Industry support. # **Internship** in Industry /R&D/ Research institute for 1-month duration to be carried out from 2nd semester onward during summer vacation and evaluation will be done at the end of 8th sem for both CIE 50 Marks and SEE 50 Marks. ## **Vyavaharika Kannada** to be completed before the end of 8th semester. **Lab courses** will have virtual experiments also.

N.M.A.M. Institute of Technology, Nitte
Scheme of Teaching and Examination 2022-23
Choice Based Credit System (CBCS)

VIII SEMESTER B.E.

Sl. No	Category	Code	Course Title	Teaching Hours / Week				Credits
				Theory /Lecture	Tutorial	Practical /Drawing	Total Contact Hours	
1	Project	20ME801	Project Phase - II			24	24	12
2	Internship	20ME802	Internship					3
3	PEC	20ME81X	Elective VI	3		0	3	3
4	OEC	20ME8XX	Open Elective II	3		0	3	3
				Total			**30**	**21**

Note: PCC – Professional Core Courses**, PEC** – Professional Elective Courses, **OEC** – Open Elective Courses * 1 hour of tutorial will be conducted. ** Choice based Course. *** An Audit course on modern tool usage in manufacturing may be considered for merit/Interested students with Industry support. # **Internship** in Industry /R&D/ Research institute for 1-month duration to be carried out from 2nd semester onward during summer vacation and evaluation will be done at the end of 8th sem for both CIE 50 Marks and SEE 50 Marks. ## **Vyavaharika Kannada** to be completed before the end of 8th semester. **Lab courses** will have virtual experiments also.

B.E in Mechanical Engineering

PROFESSIONAL ELECTIVE GROUPS

DESIGN			
GROUP 1		**GROUP II**	
Subject Code	**Subject Name**	**Subject Code**	**Subject Name**
20MEE11	Finite Element Method	20MEE21	Advanced strength of materials
20MEE12	Material selection for Engineering Design	20MEE22	Control Engineering
20MEE13	Introduction to Piping Engineering	20MEE23	Design of Experiments
20MEE14	Computer Aided Design (CAD) tool: UG NX	20MEE24	Introduction to Aircraft Design
20MEE15	Product Design & Development	20MEE25	Mechanical Vibrations
20MEE16	Design of Aircraft Structures	20MEE26	Fluid Power Systems
20MEE17	Industrial Tribology	20MEE27	Plastic Part Design & Manufacturing
THERMAL			
GROUP III		**GROUP IV**	
Subject Code	**Subject Name**	**Subject Code**	**Subject Name**
20MEE31	Wind & Solar Power Engineering	20MEE41	Renewable Sources of Energy
20MEE32	Computational Fluid Dynamics	20MEE42	Power Plant Engineering
20MEE33	Refrigeration and Air conditioning	20MEE43	Internal Combustion Engines
20MEE34	Energy Management	20MEE44	Gas Propulsion and Aerodynamics
MANUFACTURING & AUTOMATION			
GROUP V		**GROUP VI**	
Subject Code	**Subject Name**	**Subject Code**	**Subject Name**
20MEE51	CAD / CAM	20MEE61	Non Traditional Machining
20MEE52	Welding Technology	20MEE62	Additive Manufacturing
20MEE53	Automation in Manufacturing	20MEE63	Foundry Technology
20MEE54	Computer Integrated Manufacturing	20MEE64	Composite Materials Technology
20MEE55	Metal forming Theory & Practice	20MEE65	Non Destructive Testing

MANAGEMENT			
GROUP VII		**GROUP VIII**	
Subject Code	**Subject Name**	**Subject Code**	**Subject Name**
20MEE71	Human Resource Management	20MEE81	Supply Chain and Logistic Mgmt.
20MEE72	Marketing Management	20MEE82	Organizational Behavior
20MEE73	Total Quality Management	20MEE83	Management Information System
20MEE74	Operations Management	20MEE84	Operations Research
20MEE75	Maintenance & Reliability Engineering	20MEE85	Introduction to Financial Management
20MEE76	Engineering Economics	20MEE86	Innovation and Entrepreneurship
INFORMATION TECHNOLOGY			
GROUP IX		**GROUP X**	
Subject Code	**Subject Name**	**Subject Code**	**Subject Name**
20MEE91	Introduction to Artificial Intelligence	20MEE96	Microelectromechanical Systems (MEMS)
20MEE92	Introduction to MATLAB Programming	20MEE97	Introduction to Machine Learning
20MEE93	Introduction to Business Analytics with Python	20MEE98	Data Structures with C++
20MEE94	Introduction to Python Programming	20MEE99	Cloud Computing
20MEE95	Internet of Things		

Note:

Mandatory AICTE Activity Points to be earned by students admitted to BE (For more details refer to Chapter 6,AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every 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 for the award of degree through AICTE Activity Point Programme. Students transferred from other Universities 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 eighth semester Grade Card. The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, minimum hours' requirement should be fulfilled. 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, 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.

HEAT TRANSFER

Course Code	**20ME701**	**CIE Marks**	**50**
Hrs/Week	**3+2+0**	**SEE Marks**	**50**
Total Hours	**52**	**Credits**	**04**

Course Learning Objectives:

This Course will enable students to

1. Get the idea of laws related to modes of heat transfer and steady state heat conduction equations.
2. Know the importance of application of fins in heat transfer equipments and also understand unsteady conduction.
3. Know the importance of boundary layer and solve problems related to free and forced convection.
4. Understand radiation and laws governing them.
5. To design heat exchangers and study boiling, condensation and basics of mass transfer.

UNIT - I

Introductory Concepts and Definitions:

Modes of heat transfer; Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; Radiation heat transfer coefficient; combined heat transfer mechanism.

Conduction-Basic Equations:

General form of three dimensional heat conduction equation in rectangular, coordinate. Discussion (no derivation) on three dimensional conduction in cylindrical and spherical coordinate systems. Boundary conditions of first, second and third kinds.

One-Dimensional Steady State Conduction:

Steady state conduction in a slab, in a cylinder and in a sphere without heat generation. Overall heat transfer coefficient for a composite medium; thermal contact resistance; critical thickness of insulation

10 Hours

UNIT – II

Heat Conduction Through Finned Surfaces

Steady state conduction in fins of uniform cross section long fin, fin with insulated tip and fin with convection at the tip; fin efficiency. Conduction in solids with variable thermal conductivity.

One-Dimensional Transient Conduction:

Conduction in solids with negligible internal temperature gradients (Lumped system analysis); Use of transient Temperature charts (Heisler's Charts) for transient conduction in slab, long cylinder and sphere; use of transient temperature charts for transient

conduction in semi-infinite solids.

10 Hours

UNIT - III

Radiation Heat Transfer:

Thermal radiation; Definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's Law and Wein's displacement law' Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces; Effect of radiation shield; Intensity of radiation and solid angle; Lambert's Law; Radiation heat exchange between two finite surfaces - configuration factor or view factor.

Concepts and Basic Relations in Boundary Layers:

Flow over a body-Velocity boundary layer; Critical Reynolds number; General expressions for drag coefficient and drag force; Thermal boundary layer; general expression for local and average heat transfer coefficient; Nusselt number. Expressions for friction factor for hydro dynamically developed laminar flow through tubes.

11 Hours

UNIT - IV

Forced Convection:

Application of dimensional analysis for forced convection problems. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro - dynamically and thermally developed flows; use of correlations for flow over a flat plate, over a cylinder and across

Free or Natural Convection:

Application of dimensional analysis for free convection- physical significance of Grashoff number; Use of correlations for free convection from or to vertical, horizontal and inclined flat plates, vertical and horizontal cylinders.

10 Hours

UNIT - V

Condensation and Boiling:

Types of condensation; Nusselt's theory for laminar condensation on a vertical flat surface-expressions for film thickness and heat transfer coefficient; use of correlations for condensation on inclined flat surfaces, horizontal tube and horizontal tube banks; Reynolds number for condensate flow; Regimes of pool boiling-Pool boiling correlations.

Heat Exchangers:

Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD and NTU methods of analysis of heat exchangers.

Introduction to Mass Transfer: Similarity between Heat and Mass Transfer, Fick's Law of diffusion.

11 Hours

Course Outcomes (CO):	
At the end of the course the student will be able to	
CO 1	Apply the basic knowledge of mathematics, science and engineering to understand and analyze the basic laws, principles and modes of steady state conduction.
CO 2	Understand and analyze complex engineering problems related to finned surfaces and unsteady conduction.
CO 3	Apply engineering knowledge to solve complex problems of radiation heat transfer and radiation shielding to create sustainable environment.
CO 4	Understand the principles of boundary layer theory in free and forced convection heat transfer to design suitable solution to complex problems.
CO 5	Analyze and interpret complex problems related to mass transfer, boiling and condensation, and proper design of heat exchangers.

TEXTBOOKS:

1. Heat Transfer, Holman J.P., Ninth Edn. Tata McGraw –Hill, 2007
2. Shah, R. K. and Seculic, D. P.,—Fundamentals of Heat Exchanger Designǁ, Wiley India, 2012.
3. Krieth - Fundamentals of Heat Transfer, 4th Edition, Harper & Law, 2086.
4. Heat & Mass Transfer by R.K. Rajputh, S. Chand & Co (P) Ltd, 2014
5. Heat & Mass Transfer by S.C.Arora& S. Domkundvar, DhanapatRai Co (P) Ltd, 2013.
6. Heat Transfer - A Basic approach by M Necati Ozisik, McGraw Hill International edition 2088.
7. Measurement Systems Application and Design Doeblin, Mc Graw Hill education, 5th Edition, 2003.
8. Numerical Heat Transfer and Fluid Flow. Hemisphere Publishing Corporation, Taylor and Francis Group New York, 2080.

REFERENCE BOOKS:

1. —Introduction to Thermodynamics and Heat Transferǁ,Cengel, Y., 2nd Edition, McGraw Hill, 2007.
2. —Engineering Thermodynamics and Heat Transferǁ, Rogers, G. and Mayhew, Y., 4th Ed., Addison-Wesley, 2002.
3. —Principles of Heat and Mass Transferǁ, Incropera, F.P., Dewitt, D.P., Bergman, T. L. and A. S. Lavine, 7th Ed. (International Student Version), John Wiley & Sons, 2012.
4. Cengel, Y. A. and Ghajar, A. J., —Heat and Mass Transferǁ, 4th Edn., Tata McGraw Hill Education Pvt. Ltd., New Dehi, 2011.
5. Fundamental of Heat and Mass Transfer, M.Thirumaleshwar, Pearson
6. Computational Heat Transfer and Fluid Flow, Murlidhar & Sunder Rajan, Narosa
7. Thermal Engineering, M.L. Mathur & F.S. Mehta, Jain Publications
8. A Course in Heat & Mass Transfer, V.M. Domkundwar, Dhanpat Rai & Co.

MOOC/NPTEL Resources:

1. http://nptel.ac.in/courses/112101097/

Course Articulation Matrix:

Course Code / Name: 20ME701/ Heat Transfer															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20ME701.1	3	3	3	1	1	3	3	3	3	3	3	3	3	2	1
C-20ME701.2	3	3	2	2	1	2	2	3	3	3	3	3	3	2	1
C-20ME701.3	3	3	2	3	1	3	3	3	3	3	3	3	3	3	1
C-20ME701.4	3	3	2	3	1	2	2	3	3	3	3	3	3	2	1
C-20ME701.5	3	3	2	3	1	2	2	3	3	3	3	3	3	2	1

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

There will be **10** questions of **20** marks each in the question paper divided into **5** units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting **one full** question from **each** unit.

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MECHATRONICS

Course Code	**20ME702**	**CIE Marks**	**50**
Hrs/Week	**3+0+2**	**SEE Marks**	**50**
Total Hours	**52**	**Credits**	**04**

Course Learning Objectives:

This Course will enable students to

1. Understand basic mechatronic systems, mechanical components, actuators, sensors and also with controllers of mechatronic systems.
2. Gaining knowledge of pneumatic elements like valves, FRL units and pneumatic actuators
3. To familiarize with the various types mechanical switches, Solid state switches, drives and controls, characteristics and models of various electromechanical actuators.
4. Provide sound understanding of signal conversion i.e. ADC to DAC and vice versa, amplifiers, comparators and basic architecture of PLC system.
5. Understand architecture of 8085 microprocessors, micro controller, logic gates, and flip-flops

UNIT – I

Introduction: Introduction to Mechatronic systems, Measurement systems, control systems, microprocessor based controllers, Mechatronics approach. Examples and discussions on typical mechatronic systems.

Review of Transducers and Sensors: Introduction to Transducers and sensors, their classification, light sensors, proximity sensors and Hall-effect sensor, encoders, selection of sensors.

10 Hours

UNIT – II

Pneumatic Systems: Introduction, Basic structure of pneumatic systems, filter, lubricator, regulator, Valves – Classification, Pressure control valve, Flow control valve, Direction control valve. Types of cylinders, air motors, air compressors, Symbols of Pneumatic elements and application circuits.

10 Hours

Active learning component on Hydraulics and Pneumatics

UNIT - III

Drives and controls: Mechanical system: Anti Friction guide ways, timer belt and pulley, high speed precession bearings

Electrical Actuation Systems: Actuators and actuator system, classification, Mechanical switches, Solenoids, relays, solid-state switches, Motors- DC & AC motors, Stepper motors, servo motor.

12 Hours

Active learning component on DC & AC drives

UNIT – IV

Signal conditioning: Introduction to signal conditioning, Operational amplifier, Inverting, Non- inverting, Summing, Integration, Differential amplifier, protection, filtering, wheat stone bridge, Analog –Digital Converter & Digital- Analog Converter, Multiplexers, Data acquisition system. **10 Hours**

UNIT – V

Microprocessors: Introduction to microprocessor, microprocessor based digital control, Basic elements of control system, 8085 A microprocessor architecture and terminology, Microcontrollers. Differences b/w microprocessor & micro controllers. Classification of micro controllers.

Programmable logic controller: Introduction to PLC's, basic structure, Principle of operation, Programming and concept of ladder diagram, concept of latching &selection

of a PLC. Logic gates using PLC.
Active learning component on PLC **10 Hours**

Course Outcomes (CO):	
At the end of the course the student will be able to	
CO 1	Summarize significance of mechatronics to attain better performance of electro mechanic systems. Identify key elements of the mechatronic system and represent them as block diagrams. Demonstrate Hall effect, inductive, capacitive and photodiode transducers, which are used in vital mechatronic applications.
CO 2	Describe the pneumatic components such as FRL unit, Valves and pneumatic actuators along with their functions. Design, simulate and develop pneumatic circuits for Industrial applications using these pneumatic components.
CO 3	Illustrate the operational characteristics of solid-state switches, mechanical and electrical actuator systems. Identify suitable drives for mechatronics systems.
CO 4	Describe the concept of Amplifiers, Filters, Analogue and digital signal, Converters (ADC, DAC) and DAQ for its industrial applications.
CO 5	Utilize the knowledge of logic gates, microprocessor, microcontroller and PLC. Develop PLC ladder programming for industrial applications.

TEXTBOOKS:

1. —Mechatronics —, W. Bolton, pearson education, third edition. 2013
2. —Microprocessor Architecture, programming and applications with 8085.8085 R.S. Ganokar, Wiley Eastern.2087
3. Introduction to Mechatronics‖, K. K. Appukuttan, Oxford University press, 2007 edition
4. Pneumatic systems S. R Majumdar, Tata Mc.Graw-Hill, Publishing company, ltd. 2097

REFERENCE BOOKS:

1. Mechatronics, Nitaigour Premchand Mahilik, Tata Mc.Graw-Hill, Publishing company, Ltd. 2003
2. Pneumatics Basic level TP101, Peter Croser and Frank Ebel,Festo Didactic Publications. 2003
3. Fundamentals of pneumatic control engineering, J.P. Hasebrink and R.Kobbler, Festo Didactic Publications. 2078
4. A Textbook of Mechatronics, RK Raput, S.Chand Publishing

Course Articulation Matrix:

Course Code / Name : 20ME702 / Mechatronics															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20ME702.1	3	1	1		1				3	1		2	3	1	2
C-20ME702.2	3	2	2	2	2				2	1	2	2	3	1	2
C-20ME702.3	3	2	3	2	3				3	2	2	3	3	1	2
C-20ME702.4	3	2	2	1	2				2	1	2	2	3	1	2
C-20ME702.5	3			2	3				2	2	2	3	3	1	2

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

There will be **10** questions of **20** marks each in the question paper divided into **5** units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting **one full** question from **each** unit.

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HEAT TRANSFER LAB

Course Code	**20ME703**	**CIE Marks**	**50**
Hrs/Week	**0+0+2**	**SEE Marks**	**50**
Total Hours	**26**	**Credits**	**01**

The students are required to carry out any 10 experiments from the following list.

1. Determination of Thermal conductivity of a Metal rod.
2. Determination of overall heat transfer coefficient of a Composite Wall.
3. Determination of Effectiveness on a metallic fin.
4. Determination of Heat Transfer co-efficient in a free convection wall.
5. Determination of Heat Transfer co-efficient in a forced convention flow through a pipe.
6. Determination of emissivity of a surface.
7. Determination of Stefan Boltzman constant.
8. Determination of LMTD and effectiveness in a parallel flow and counter flow Heat exchanger.
9. Experiments on Boiling of liquid and condensation of vapour.
10. Performance Test on a Vapour Compression Refrigerator.
11. Performance test on a Vapour Compression Air-conditioner.
12. Experiment on Transient conduction Heat Transfer.

Virtual Lab Experiments

13. Determination of Stefan's Constant
14. Heat transfer by Conduction

Course Outcomes (CO):	
At the end of the course the student will be able to	
CO 1	Conduct the experiments on steady state heat conduction through composite planes, composite cylinders, composite spheres, metal rod, insulating powder and liquids. Calculate the temperature distribution and rate of heat transfer. Determine the effectiveness of parallel flow and counter flow heat exchangers.
CO 2	Conduct natural convection, forced convection and radiation experiments and Determine rate of heat transfer. Conduct experiments on refrigeration and air conditioner and determine coefficient of performance.

Course Articulation Matrix:

Course Code / Name: 20ME703/ Heat Transfer Lab															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C-20ME703.1	2	3							3	2		1	1	1	
C-20ME703.2	2	3							3	2		1	1	1	

1: Low 2: Medium 3: High

Scheme of Examination:

Students are required to carry out **Two** experiments in Semester End Exam

Experiment 1: 20 marks

Experiment 2: 20 marks

Viva Voce: 10 marks

Total: 50 Marks

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DYNAMICS LAB

Course Code	**20ME704**	**CIE Marks**	**50**
Hrs/Week	**0+0+2**	**SEE Marks**	**50**
Total Hours	**26**	**Credits**	**01**

Course Learning Objectives:

This Course will enable students to

1. Recall the difference between kinetics and dynamics through experiments.
2. Visualize the stresses developed in an object through photo elasticity experiments.
3. Visualize and analyse the flow pressure distribution across and along the Journal bearing.

UNIT - I

Free vibration experiments

1. Determination of time period and acceleration due to gravity using simple pendulum
2. Determination of time period, radius of gyration and acceleration due to gravity of Kater's reversible pendulum
3. Determination of time period, radius of gyration and acceleration due to gravity of compound pendulums- circular, elliptical, rectangular, triangular, square plates
4. Determination of center of percussion of compound pendulums
5. Determination of time period/natural frequency of vibration of spring mass combination systems-series, parallel, parallel-series
6. Determination of time period/natural frequency of vibration of an equivalent spring-mass system
7. Determination of radius of gyration of a given body using bifilar/trifilar suspension

UNIT – II

Torsional vibration experiments

8. Verification of Dunkerley's relationship
9. Static and dynamic balancing of rotating masses
10. Determination of time period/natural frequency of vibration of a single rotor and two rotor system
11. Study of damped torsional oscillation system

UNIT – III

Forced vibration experiments

12. Determination of critical speed of a shaft
13. Study of pressure distribution in a journal bearing apparatus

UNIT - IV

(Demonstration only)

14. Determination of damping ratio, damping coefficient, undamped and damped natural frequency of a single degree freedom system for forced vibration and plot the magnification factor vs the frequency ratio.
15. Determination of fringe constant of photoelastic materials using
    a) Circular disc subjected to diametral compression
    b) Pure bending specimen (four point bending)

Virtual Lab Experiments for demonstration

16. Free vibration of simply supported beam
17. Free vibration of cantilever beam
18. Free vibration of fixed beam
19. Rotating Unbalance

Course Outcomes (CO):	
At the end of the course the student will be able to	
CO 1	Conduct simple experiments regarding free vibration involving linear motion and determine time period, natural frequency, center of percussion, radius of gyration and acceleration due to gravity.
CO 2	Conduct torsional vibration experiments and verify the effect of damping on natural frequency and time period and determine the damping ratio and logarithmic decrement.
CO 3	Conduct forced vibration experiments and determine critical speed of the shaft. Determine pressure distribution in a journal bearing.

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, 2083

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.
(5) Mechanical Vibrations, S. S. Rao, Pearson Education Inc, 4PthP Edition, 2003.
(6) Mechanical Vibrations, V. P. Singh, DhanpatRai& Company Pvt. Ltd., 3PrdP Edition, 2006.

Course Articulation Matrix:

Course Code / Name : 20ME704 / Dynamics Lab															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20ME704.1	2	3	1	2	-	1	1	-	3	1	-	1	2	-	1
C-20ME704.2	2	3	1	2	-	1	1	-	3	1	-	1	2	-	1
C-20ME704.3	2	3	1	2	1	1	1	-	3	1	-	1	2	-	1

1: Low 2: Medium 3: High

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TECHNICAL SEMINAR

Course Code	**20ME705**	**CIE Marks**	**50**
Hrs / Week :	**0+0+2**	**SEE Marks**	**---**
		Credits	**01**

Course Learning Objectives: This Course will enable students to,	
1	Prepare seminar presentations using visual aids and seminar reports.
2	Make oral presentation with proper communication and body language.
3	Answer all technical queries regarding the seminar topic presented.

Course Outcomes (CO):	
At the end of the course the student will be able to	
CO 1	Make effective presentations, with proper communication and body language.

Course Articulation Matrix:

Course Code / Name : 20ME705 / Seminar															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20ME705.1	-	2	-	-	3	-	-	-	3	3	-	3			

1: Low 2: Medium 3: High

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PROJECT PHASE - I			
Course Code	**20ME706**	**CIE Marks**	**50**
Hrs/Week	**0+0+3**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Project work: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6.

Preparing a project - brief 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.

CIE procedure for Project Work Phase - 1:

(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 phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), 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 phase -1, shall be based on the evaluation of project work phase -1 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.

Course Outcomes (CO):

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

CO1	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.
CO2	Choose suitable raw material considering the financial feasibility
CO3	Develop a Model / System and analyse it is using suitable Computational tool
CO4	Prepare a technical report and demonstrate the project progress through oral presentation

Course Articulation Matrix:

Course Code / Name : 20ME706 / Project Part-I															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C-20ME706.1	-	-	2	2	1	3	1	3	1	3	3	1	2	2	2
C-20ME706.2	-	-	-	-	-	2	1	1	3	1	3	1	-	-	-
C-20ME706.3	-	-	3	3	3	1	1	1	3	1	1	2	3	3	3
C-20ME706.4	-	-	-	1	1	1	1	3	3	3	1	1	1	1	1

1: Low 2: Medium 3: High

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PROJECT PHASE– II			
Course Code	**20ME801**	**CIE Marks**	**100**
Hrs/Week	**0+0+9**	**SEE Marks**	**100**
		Credits	**12**

The project work involves the following:

- **A report highlighting the design finalization [based on functional requirements & standards (if any)]**
- **Fabrication, assembly, testing and performance analysis of the designed project**
- **A presentation including the following:**
  - Implementation Phase (Hardware / Software / both)
  - Testing & Validation of the developed system
  - Learning in the Project
- **Consolidated report preparation**

Objectives of the course on project work:

- To expose engineering students to technology development at workplaces and appraise them regarding shop-floor problems.
- 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.
- 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 5-6 students be guided by one faculty member during this period.

CIE procedure for project phase II is same as that of project phase I
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.

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.

Course Outcomes (CO):	
At the end of the course the student will be able to,	
CO 1	Create a model/prototype through fabrication, simulation, data analysis, Experimentation
CO 2	Compose a technical paper/propose an idea and defend its novelty and suitability to the current need of the society/industry
CO 3	Prepare a technical report and demonstrate the project work through oral presentation

Course Articulation Matrix:

Course Code / Name: 20ME801/ Project-II															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20ME803.1	-	-	-	2	3	1	1	1	3	1	1	2	3	3	3
C-20ME803.2	-	-	-	3	1	3	3	3	3	3	3	3	3	3	3
C-20ME803.3	-	-	-	1	1	1	1	3	3	3	1	1	1	1	1

1: Low 2: Medium 3: High

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INTERNSHIP			
Course Code	**20ME802**	**CIE Marks**	**50**
		SEE Marks	**50**
		Credits	**03**

Internship: All the students admitted to BE shall have to undergo mandatory internship of 4 weeks during the vacation at the end of 4th, 5th,6th and/or 7th semester. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not takeup/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.

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PROFESSIONAL ELECTIVES

FINITE ELEMENT METHOD			
Course Code	**20MEE11**	**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 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 – I

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.

8 Hours

Principle of minimum potential energy, Rayleigh – Ritz method, Galerkins Method, Numerical Integration**.** **8 Hours**

UNIT – II

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.

8 Hours

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. **8 Hours**

UNIT – III

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

Course Outcomes (CO):

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

CO 1	Explain the basic steps in the finite element method
CO 2	Apply the direct stiffness, Rayleigh-Ritz, Galerkin method to solve static structural problems.
CO 3	Establish shape functions for various elements to arrive at elemental stiffness matrices and load vectors to obtain global equilibrium equation.
CO 4	Analyze bar and truss elements by applying suitable boundary conditions to compute displacements, stresses and support reactions.
CO 5	Compute deflection and slope in beams subjected to Point load and UDL; Determine stress in 2D plate using finite element method.

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
7. A Textbook of Finite Element Analysis, Seshu, Phi, 2013

MOOC/NPTEL Resources:

1. http://nptel.ac.in/courses/112104115/

Course Articulation Matrix

Course Code / Name : 20MEE11/Finite Element Method															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE11.1	1	2	3					1	1	1		1	3		1
C-20MEE11.2	1	2	3		1			1	1	1		1	3		1
C-20MEE11.3	1	2	3		1			1	1	1		1	3		1
C-20MEE11.4	1	2	3		1			1	1	1		1	3		1
C-20MEE11.5	1	2	3	1	1			1	1	1		1	3		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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MATERIAL SELECTION FOR ENGINEERING DESIGN

Course Code	**20MEE12**	**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 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 – I

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**

UNIT – II

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

UNIT - III

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**

Course Outcomes (CO):

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

CO 1	Describe the design process for an engineering product and discuss the conceptual and configuration design aspects of the product. Explain the mechanical properties of engineering materials.
CO 2	Explain the effects of composition, structure and processing on material properties and use the material property chart to select the appropriate materials for engineering applications.
CO 3	Explain the wear mechanisms. Explain design for plastics and composites.
CO 4	With a case study discuss the process selection using process selection chart.
CO 5	Explain the material selection of a component with multiple constraints and conflicting objectives

TEXTBOOK :

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

REFERENCE BOOKS :

1. ASM Hand book of Materials Selection and Deign, 2096
2. Engineering Materials Properties and Selection, Budinski and Budinski, PHI

Course Articulation Matrix:

Course Code / Name : 20MEE12 / Material Selection for Engineering Design															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE12.1	3	1	-	-	-	-	-	-	1	1	-	1	2	1	-
C-20MEE12.2	3	2	-	-	-	-	-	-	3	3	-	1	2	1	-
C-20MEE12.3	3	1	-	-	-	-	-	-	2	1	-	1	2	-	-
C-20MEE12.4	3	-	-	-	-	-	-	-	1	1	-	1	2	1	-
C-20MEE12.5	3	-	-	-	-	-	-	-	1	1	-	1	2	-	-

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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INTRODUCTION TO PIPING ENGINEERING

Course Code	**20MEE13**	**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 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 – I

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. **15 Hours**

UNIT – II

Thick and thin cylinders. Hoop stress, pipe thickness calculations. Basics of piping and equipment layout, piping symbols, plans and isometrics. Piping arrangements, pipe rack layout, types of racks, width calculation . General Arrangement Drawing, Process and Instrumentation Drawing. **17 Hours**

UNIT - III

Pipe under stress, classification of loads and failures. Theories of failure. Methods of flexibility analysis, pipe supports. 7 Hours

Course Outcomes (CO):

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

CO 1	Describe the scope of piping engineering and fundamentals of piping with respect to the petrochemical industry. Categorize and identify codes, standards and piping materials.
CO 2	Categorize the piping components and discuss the working of valves, flanges and specialty items used in the piping system.
CO 3	Calculate the wall thickness of thin and thick cylinders using fundamentals and codes.
CO 4	Explain pipe routing and sketch the isometric drawing from given General Arrangement Drawing.
CO 5	Classify different types of loads acting on pipes and interpret the behavior of different types of supports in a piping system.

TEXTBOOK:

1. Mohinder L Nayyra —Piping Hand bookǁ

REFERENCE BOOKS:

1. Henry H. Bender, —Pressure Vessels, Design Hand Book", CBS Publishers and Distributors, 2087.
2. Stanley, M. Wales, "Chemical Process Equipment, Selection and Design. Butterworth's series in Chemical Engineering", 2088.

Course Articulation Matrix:

Course Code / Name : 20MEE13 / Introduction to Piping Engineering															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE13.1	3	1	-	-	-	-	-	-	1	1	-	1	2	-	-
C-20MEE13.2	3	1	-	-	-		-		1	1	-	1	1	-	-
C-20MEE13.3	3	3	-	-	-	-	-	-	1	1		1	3	-	-
C-20MEE13.4	3	3	-	1	-		-	-	1	1	-	1	2	-	-
C-20MEE13.5	3	1	-	1	-	-	-	-	1	1`	-	1	2	-	-

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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COMPUTER AIDED DESIGN (CAD) TOOL: UG NX			
Course Code	**20MEE14**	**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 various coordinate systems and software interface.
2. Understand the various geometric relationships and feature creations.
3. To be familiar with the various commands of creation and modifying features.
4. Students must be able to load and assemble the various parts and convert them to 2D drawings.
5. Understand basics of GD&T and stack up analysis.

UNIT - I

Introduction to CAD theory: Introduction to NX, file overview, layers.
Activities: Opening and working with parts.
NX CAD tool interface: User Interface Preferences, roles, NX layout configuration between sessions.
Activities: Getting to know the NX interface: Toolbars and roles
Coordinate systems on parts: Coordinate systems on parts, WCS options, WCS dynamics overview, impact of coordinate systems on parts.
Creating parts with sketches: Sketch overview, types of constraints, sketch dimensions, convert to / from reference, CAD environment.
Activities: Create constraints
Projects: Simple sketching. **7 Hours**

UNIT - II

Sweeping geometry to create part features: Types of swept features, internal and external sketches, extrude, combine bodies using Boolean commands, revolve and sweep along guide. Activities: sweeping geometry to create part features
Projects: Simple sweeps

Creating and editing geometric relationships with formulas: Expressions, parameter entry options, Expression options.
Activity: Creating and editing geometric relationships with formulas
Creating datum geometry to support design intent: Datum plane, create datum planes. Activities: Creating datum geometry to support design intent, applications for a datum CSYS. **Structure of a model:** Part navigator, feature replay, reorder feature, feature dimension measurements, delayed updates.
Activity: Examining the structure of a model. **8 Hours**

UNIT – III

Editing and manipulating sketches: Auto constrain, auto dimension, edit dimension associativity, attach a dimension to different geometry, reattach sketch, mirror curve, sketch evaluation and update techniques.

Activity: Auto dimensioning rules

Trimming a solid body, creating swept features with offset and draft: Extrude with offset, two sided offset examples, single sided offset examples, extrude with draft, design logic parameter entry options.

Project: Advanced sweeps

Creating and editing holes, Creating and manipulating shell features, Copying and Mirroring part segments. **8 Hours**

UNIT – IV

Blending and chamfering edges, modifying geometry of imported parts

Loading and working with assemblies: Introduction to NX assemblies, component objects, part files, load states, scope group, assembly navigator display commands.

Activity: Part revisions and saving assemblies.

Projects: Shell, associative copies, blends and chamfers.

Adding and positioning parts in an assembly

Activity: Create an assembly, move component, assembly constraints, show degrees of freedom.

Drafting / Creating simple drawings: Drafting application, model based drafting process, master model concept, the drafting interface, setting and changing the style of your view.

Activity: Create notes and labels

Projects: Create simple drawings **8 Hours**

UNIT – V

Geometric Dimensioning and Tolerancing + Stack up Analysis

Basics of GD&T: Tolerances of form, straightness, flatness, circularity, cylindricity,

angularity, perpendicularity, parallelism, tolerances of runout, circular runout, total runout, tolerances of profile, profile of a surface, tolerances of location, true position, concentricity, symmetry, coordinate vs geometric tolerancing methods.

Activity& Project **4 Hours**

Stack up Analysis

Introduction to Stack Up analysis

Activity & Project **4 Hours**

(Activities and projects are considered for internal assessment only).

Course Outcomes (CO):

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

CO 1	Acquire the knowledge about coordinate systems and software interface in UG NX.
CO 2	Model parts with various feature creations.
CO 3	Edit and manipulate sketches using advanced tools.
CO 4	Load and assemble the various parts in assembly environment and convert them to 2D drawings.
CO 5	Develop GD&T relationships to the models and use stack up analysis

TEXTBOOKS:

1. Radhakrishnan P and Subramanyan S, —CAD/CAM/CIM‖, New Age International (P) Ltd., 2004.
2. P. N. Rao, —CAD/CAM Principles and Applications‖, 2nd Edition, TMH education, 2007.

REFERENCE BOOKS:

1. Radhakrishnan P and Kothandaraman C P, —Computer Graphics and Design‖, Dhanpat Rai and Sons, New Delhi, 2002.
2. Vera B Anand, "Computer Graphics and Geometric Modeling for Engineers", John Wiley and Sons Inc., New Delhi, 2000.

Course Articulation Matrix:

Course Code / Name : 20MEE14 / Computer Aided Design (CAD) tool: UG NX															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE14.1	1	2	3	1					1			1	2		2
C-20MEE14.2	1	2	3		3							1	3		2
C-20MEE14.3	1	2	3							3			2		2
C-20MEE14.4	1	2	3	3	3							1	3		2
C-20MEE14.5	1	2	3	3						1		2	3		2

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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PRODUCT DESIGN & DEVELOPMENT

Course Code	**20MEE15**	**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 various types and processes of product development and opportunity identification.
2. Understand the product development planning and specifications.
3. Acquire skill in concept generation, selection and testing.
4. To know product architecture, need for industrial design and life cycle of a product.
5. To design the prototype and overview of patents and intellectual property right.

UNIT – I

Chapter 1:

Introduction: Introduction to product development, importance, types of product development, advantages of structured methods.

Development Processes and organizations: Product development process, product development organizations.

Discussion: How offshore team supporting product development.

Opportunity Identification: Process of opportunity identification in various industries.

Activity: Implementation of bug list**.** **8 Hours**

Chapter 2:

Product planning: Product development opportunities, market competition, technology portfolio planning, mission statement.

Activity and discussion.

Product specifications: Introduction, importance of specification, establishing target specifications, setting final specifications.

Activity / Project: Students to establish specification for 2 wheeler bike for 18 – 24 years

8 Hours

UNIT - II

Chapter 3:

Concept generation: Introduction, Process and Practice

Activity / Project: Vegetable peeler

Concept selection: Introduction, concept screening, concept scoring

Activity / Project:Select the best solution

Concept testing: Overview, purpose, process of survey
Activity / Project: Testing of the selected concept
Product Architecture: Overview of product architecture, establishing architecture, factors affecting product architecture, planning and design issues
Activity / Project:Planning & designing **8 Hours**

Chapter 4:
Industrial Design: Overview, need for industrial design, industrial design process, discussion with guest lecture.
Design for Environment: Introduction, life cycle of a product, life cycle assessment
Activity / Project: LCA of shoes and packaging to minimize the damage
Design for Manufacturing: Overview / introduction, DFM principles
Activity: DFM Exercise **8 Hours**

UNIT - III

Chapter 5:
Prototyping: Overview / introduction, prototyping methods, finishing of prototypes, discussion
Robust design: Overview / introduction, identify control factors, noise factors and performance metrics, developing and running experimental plan, conduct the analysis.
Patents and Intellectual Property: Overview / Introduction, patents & IP
Discussion: Indian process of filing a IP / Design patent 7 **Hours**

Course Outcomes (CO):

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

CO 1	Explain the basic principles of product development.
CO 2	Identify and formulate contrast between development and planning.
CO 3	Explain the fundamentals of concept generation, selection and testing.
CO 4	Demonstrate product architecture, industrial design and life cycle of a product.
CO 5	Develop a prototype and acquire basic knowledge about patents and intellectual property.

TEXTBOOKS:

1. Karl T Ulrich, Steven D Eppinger, Anita Goyal, —Product Design and Development‖, Tata McGraw-Hill, 2009.
2. Kevin Otto and Kristin Wood, —Product design‖- Pearson, 2004
3. Mike Ashby, Kara Johnson, —Materials and Design: The Art and Science of Material Selection in Product Design‖, Butterworth Heinemann, 2009.
4. Edward Magrab, —Integrated product and process design and Development‖, CRC Press, 2009.

REFERENCE BOOKS :

1. Chitale A.K, Gupta R.C, —Product Design and Manufacturing‖, Prentice Hall Of India, 2009.
2. Lal G.K, Vijay Gupta, Venkata Reddy.N, —Fundamentals of Design and Manufacturing‖, Narosa Book Distributors Private Limited, 2010.

Course Articulation Matrix:

Course Code / Name: 20MEE15 / PRODUCT DESIGN & DEVELOPMENT															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE15.1	3	1	1					1	1	3	1		1	1	
C-20MEE15.2	3	2	1					2	2	3	3		2	1	
C-20MEE15.3	3	3	2					2	2	3	3		2	1	
C-20MEE15.4	3	3	2					2	3	3	2		3	2	
C-20MEE15.5	2	3	2					2	2	2	2		2	2	

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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DESIGN OF AIRCRAFT STRUCTURES

Course Code	**20MEE16**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

This Course will enable students to

1. Get an exposure to the aircraft design, loads and materials.
2. Understand the Basics of Aircraft Systems and Aircraft Structures.
3. Industry Practices on Design of Aircraft Structures.
4. Understand the applicability of Design aspects in Aircraft Design.
5. Relate the theoretical knowledge with the design of Aircraft Structures.

UNIT – I

Chapter 1 - Overview of the Aircraft Design Process

Introduction, Phases of Aircraft Design, Aircraft Conceptual Design Process, Conceptual Stage, Preliminary Design, Detailed Design, Design Drivers, Take of weight estimation using design example: ASW aircraft.

Airworthiness- Definition, Airworthiness Regulations, Regulatory Bodies, US FAR and Subparts of FAR Part 25, Type certification, General Requirements, Requirements Related to Aircraft Design - Performance and Stability Requirements, Airframe (strength) Requirements, Landing Requirements, Fatigue and Damage tolerance requirements, Emergency Provisions, Emergency Landing requirements.

4 Hours

Chapter-2 -Aircraft Loads

Aerodynamic Loads, Inertial Loads, Loads due to engine, Actuator Loads, Maneuver Loads, V-n diagrams, Gust Loads, Ground Loads, Ground conditions, Miscellaneous Loads. Simple numerical examples.

2 Hours

Chapter 3 - Aircraft Structures Description

Types of Structural members of Fuselage and wing section and empennage, Splices,
Types of structural joints, splices and fuselage floor structure.

Chapter 4 - Materials

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

3 Hours

Chapter 5- 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, Introduction to high cycle fatigue.

4 Hours

UNIT – II

Chapter 6-Theroy 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.

8 Hours

Chapter 7- Box Beams

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

4 Hours

Chapter -8 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.

8 Hours

UNIT – III

Chapter 9- Aircraft Structural Joints

Introduction, Fasteners, Splices, and Eccentric joints-Bolt Group Analysis, Lug Analysis (Lugs loaded axially only), Tension Fitting and clips, Welded joints, Bonded joints.

3 Hours

Chapter10- Advanced materials, Vibrations and Flutter

Introduction to Comp Materials, Matrices, Fibers, Forms, Characteristics of composite materials, Brief overview of static and dynamic aero elasticity (definition and importance only) **3 Hours**

Course Outcomes (CO):

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

CO 1	Describe different phases of aircraft design and differentiate between various methodologies used in aircraft design based on different types of loads acting on the aircraft.
CO 2	Describe basic construction and material forms of aircraft structures, differentiate between different normal metals, alloys, composite materials and their application in different structures and solve problems related to Principal stresses and strain. Describe static and fatigue stress effects, describe thermo mechanical Fatigue and high cycle fatigue and describe Multi axial stress effects.
CO 3	Analyze axially loaded structures using method of joints and method of sections, deflection of beams, symmetric unsymmetric and plastic bending cases, describe the state Euler's equation for columns, determine effective column length and analyze the crippling effect on columns.
CO 4	Describe and apply the concept of shear flow, the concept of diagonal tension, the concept of Euler's buckling, the significance of buckling of thin plates, the concept of diagonal tension and buckling under combined loads
CO 5	Classify different aircraft structural joints, analyze bolt groups for strength and other considerations, analyze bonded joints and lugs and analyze tension fittings and clips.

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, 2088,2nd Edition.
3. Airframe Stress Analysis and Sizing by Michael Niu, Conmilit Press, 2099,3rd Edition
4. Aircraft Structures for engineering students by T. H. G. Megson, Butterworth-Heinemann, Third Edition

REFERENCE BOOKS:

1. The Elements of Aircraft Preliminary Design – Roger D. Schaufele, Aries Publications, 2000.
2. An Introduction to Aircraft Certification; A Guide to Understanding Jaa,Easa and FAA by Filippo De Florio, Butterworth-Heinemann

Course Articulation Matrix:

Course Code / Name : 20MEE16 / Design of Aircraft Structures															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE16.1	1	2	2	1			3	1	3				3		
C-20MEE16.2	3	3	2	1			3	1	2				3		
C-20MEE16.3	3	3	3				3	1	1				3		
C-20MEE16.4	3	3	3				3	1	1				3		
C-20MEE16.5	2	2	2	2	1	1	3	1	3	1	2	1	3	2	

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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INDUSTRIAL TRIBOLOGY

Course Code	**20MEE17**	**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 recollect the phenomenon of friction and the theories of friction. To discuss the effect of friction on component life.
2. 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.
3. 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.
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 capasity, oil flow and power loss in hydrostatic step bearing.

UNIT – I

Introduction: Introduction to Tribology, introduction to micro/ nano tribology Lubrication and 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, Friction forces and power loss in lightly loaded bearing.

10 Hours

UNIT – II

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**

UNIT – III

Hydrodynamic lubrication– Mechanism of pressure development Tower's Experiments Reynold's equation in two dimensions, 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. **14 Hours**

Hydrostatic lubrication – introduction, Hydrostatic step bearing – load carrying capacity, oil flow, stiffness, and numerical problems**.** **5 Hours**

Course Outcomes (CO):

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

CO 1	Interpret frictional behavior in metals and nonmetals.
CO 2	Discuss different types of wear and apply various surface treatment methods.
CO 3	Recall the concepts related to the flow of fluids and illustrate the use of lubrication and lubricants.
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.

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., 2099.
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

MOOC/NPTEL Resources:

1. MOOC/NPTEL Resources:

Course Articulation Matrix:

Course Code / Name: 20MEE17/ Industrial Tribology															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE17.1	1	2	1	2	2	-	2	-	-	-	-	-	3		
C-20MEE17.2	1	2	2	3	2	-	2	-	-	-	-	-	3		
C-20MEE17.3	3	3	2	3	3	-	3	-	-	-	-	-	3		
C-20MEE17.4	3	3	3	3	3	-	3	-	-	-	-	-	3		
C-20MEE17.5	3	3	2	2	3	-	3	-	-	-	-	-	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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ADVANCED STRENGTH OF MATERIALS			
Course Code	**20MEE21**	**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 components of stresses in structures subjected to different loads.
2. Understand the components of strains and analyze the stress-strain relations.
3. Analyze the two-dimensional problems in Cartesian co-ordinates
4. Analyze the two-dimensional problems in polar co-ordinates.
5. To study the concepts of torsion in solid circular, elliptical and thin tubes and membrane analogy.

UNIT – I

Chapter 1 - Stress

Definition notation and sign convention of stress; Equilibrium equations, Stress components on an arbitrary plane; Principle stresses- maximum shear stress, octahedral stresses- boundary conditions, Numerical.

8 Hours

Chapter 2 – Strain

Definitions – strain - displacement relations - compatibility equations Principal strains- Generalized Hooke's law, Numerical.

Saint Venant's Principal- Principal of super position. **8 Hours**

UNIT – II

Chapter 3 - Two dimensional problems in Cartesian co-ordinates

Plane stress and plane strain conditions- Bi-harmonic equation- Investigation of Airy's stress function for simple beam problems- Solution for cantilever beam under end load.

8 Hours

Chapter 4 - General equations in Polar co-ordinates

General equations in polar co-ordinates, Stress distributions symmetrical about an axis, Numerical.

Discs

Stresses in rotating hallow and solid discs. **7 Hours**

UNIT - III

Chapter 5 - Torsion

Torsion of solid circular and elliptical bars- torsion in thin tubes, membrane analogy

8 Hours

Note: Students should solve any one problem from the entire course using ‗Matlab software' and compare the solution with the analytical solution for task-3.

Course Outcomes (CO):

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

CO 1	Calculate the state of stress in an arbitrary plane and principal stresses using equilibrium equations and boundary conditions.
CO 2	Apply the concept of strain-displacement relationship and compatibility equations to calculate the state of strain in an arbitrary plane, principal strains. Analyze stress -strain relationships using generalized Hooke's law.
CO 3	Apply the concept of Airy's stress functions and Biharmonic equations, analyze the stresses in 2-D problems and beams in the Cartesian coordinate system.
CO 4	Analyze the stresses in the cylinder and rotating disc by using the concept of compatibility equations and Biharmonic equations in the polar coordinate system.
CO 5	Calculate torsional stresses in solid circular, elliptical bars using warping function and stress-function method. Determine shear flow and shear stress distribution in thin members using membrane analogy.

TEXTBOOKS :

1. **"Theory of Elasticity",** Timoshenko and Goodier, Tata McGraw Hill Book Company, Third Edition, 2010.
2. **"Applied Elasticity",** Wang.C.T., McGraw Hill, 2053.
3. **"Advanced Mechanics of Solids",** L S Srinath, Third Edition, Tata McGraw Hill Company, 2009.
4. **"Theory of Plasticity and Metal forming Process**‖, Sadhu Singh, Khanna Publishers, Delhi, 2099.

REFERENCE BOOKS :

1. —Advanced Mechanics of Materials‖, Cook R D, and Young, John Wiley Co., New Delhi, 2087.
2. —Advanced Strength of Materials‖, Den Hartog, McGraw Hill Inc., New Delhi, 2075
3. —Theory of Elasticity‖, Sadhu Singh, Khanna publishers, 2010..
4. —Applied Elasticity‖, T.G.Sitharam, Interline publishing, 2008.
5. —Strength of Materials‖, D.S. Bedi, Khanna Publishing House
6. —Strength of Materials‖, R Subramanian, Oxford University Press
7. —Strength of Materials‖, RK Bansal, Laxmi Publications
8. —Mechanics of Materials‖, Punmia, Jain and Jain, Laxmi Publications

E-BOOKS:

1. A. I. Lurie,‖**Theory of Elasticity**‖, Springer, 2005
2. J.N. Goodier and P.G.Hodge, —**Elasticity and Plasticity**‖, Dover Publications, 2016.
3. E. Starovoitov, F.B.O Naghiyev, —**Foundations of the Theory of Elasticity, Plasticity, and Viscoelasticity**‖, CRC Press, Taylor and Francis, 2013.

MOOC/NPTEL resources:

1. http://nptel.ac.in/courses/105108070
2. https://www.coursera.org/learn/mechanics-1

Course Articulation Matrix:

Course Code / Name : 20MEE21 / Advanced Strength of Materials															
Course Outcomes (CO)	**Program Outcomes (PO)**											**PSO**			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE21.1	3	2	-	-	1	-	-	-	1	1	-	1	3	-	-
C-20MEE21.2	3	2	-	-	1	-	-	-	1	1	-	1	3	-	-
C-20MEE21.3	2	3	-	-	1	-	-	-	1	1	-	1	3	-	-
C-20MEE21.4	2	3	-	-	1	-	-	-	1	1	-	1	3	-	-
C-20MEE21.5	2	3	-	-	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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CONTROL ENGINEERING

Course Code	**20MEE22**	**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 basic concept of control Engineering.
2. Know how to obtain mathematical model and transfer function of control system.
3. Obtain the response equation of control system.
4. Understand the concept of stability.
5. Obtain the stability of system using various methods.

UNIT – I

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

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

UNIT – II

System Responses: Types of input signals, First order and second order system response to step input, steady-state error, system types, System stability criteria, Routh criteria.

Frequency Response: Polar and rectangular plots for the frequency response, Nyquist stability criterion, stability analysis. Phase and gain margin.

System Analysis using logarithmic plots: Bode diagrams: Stability analysis using Bode diagrams, simplified Bode diagrams.

MATLAB demo on System response and Frequency response.

16 Hours

UNIT - III

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

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

MATLAB demo on root locus plot and basic controllers

8 Hours

Course Outcomes (CO):	
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.

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.** (2068) —Automatic controls‖, 2PndP edition, International Text Book Co. U.S.A.
2. **Gopal M** (2005) ‖ Modern Control Systems‖, New Age International Publisher
3. **Benjamin.Kuo.C.** (2095) —Automatic Control Systems‖, EEE, 7PthP Edition Prentice Hall of India Ltd. New Delhi
4. **Appukuttan K. K.** Control Engineering, Oxford university publication, 2009

MOOC/NPTEL Resources:

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

Course Code / Name : 20MEE22 / Control Engineering															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE22.1	1	3	2						1	1		1	3		
C-20MEE22.2	1	3	2						1	1		1	3		
C-20MEE22.3	1	3	2						1	1		1	3		
C-20MEE22.4	1	3	2						1	1		1	3		
C-20MEE22.5	1	3	2						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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INTRODUCTION TO AIRCRAFT DESIGN

Course Code	**20MEE24**	**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 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 - I

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. **13 Hours**

UNIT – II

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.

Maneuvers: Aerobatics – Loop, spin, Inverted Maneuvers – inverted loop **13 Hours**

UNIT – III

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 protection systems and Air- Conditioning Systems, Brief overview electronics.

13 Hours

Course Outcomes (CO):	
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.

TEXTBOOKS :

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

REFERENCE BOOKS :

1. Introduction to Flight by Dave Anderson
2. Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration by Ian Moir, Allan Sea Bridge.
3. Fundamentals of Flight, Shevell, Pearson Education, 2nd Edition.

Web 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/2099/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 : 20MEE24 / INTRODUCTION TO AIRCRAFT DESIGN															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE24.1	3	1						1	1	1			1	1	
C-20MEE24.2	3	1	1					1	1	1			1	3	
C-20MEE24.3	3	1	1					1	1	1			2	1	
C-20MEE24.4	3	1						1	1	1			1	1	
C-20MEE24.5	3	2						1	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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MECHANICAL VIBRATIONS

Course Code	**20MEE25**	**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 fundamentals of mechanical vibrations and understand the basic concepts, principles and theory.
2. Understand the significance of damping in real world systems which are subjected to vibrations.
3. Realize the importance of forced vibrations and the different theoretical methods available to simulate it and study their responses and its effect in real world systems.
4. Get a feel of what two degree of freedom systems mean and their characteristics and to know the importance of vibration measurement and its applications.
5. Apply numerical methods to solve multi-degree of freedom system problems.

UNIT - I

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

UNIT – II

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

UNIT – III

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.

09 Hours

Course Outcomes (CO):

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.
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.

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, 2083

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.

MOOC/NPTEL 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: 20MEE25/Mechanical Vibrations															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE25.1	1	2	3	0	0	1	0	0	0	0	0	1	3	0	0
C-20MEE25.2	1	3	1	0	0	1	0	0	0	0	0	1	3	0	0
C-20MEE25.3	1	2	3	1	0	1	0	0	0	0	0	1	3	0	0
C-20MEE25.4	1	2	3	0	0	1	0	0	0	0	0	1	3	0	0
C-20MEE25.5	1	3	2	0	0	1	0	0	0	0	0	1	3	0	0

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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FLUID POWER SYSTEMS

Course Code	**20MEE26**	**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 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 simple pneumatic circuits.

UNIT – I

FLUID POWER PRINCIPLES AND FUNDAMENTALS

Introduction to Fluid power - Advantages and Applications - Fluid power systems -Types of fluids - Properties of fluids - Basics of Hydraulics - Pascal's Law -Principles of flow - Work, Power and Torque, Types of Hydraulic fluid petroleum based, synthetic & water based. Properties of fluids, Basic structure of hydraulic, advantages and disadvantages of hydraulic system.

4 Hours

PUMPS: Types, classification, principle of working & constructional details of vane pump, gear pumps, radial & axial piston pumps, Power and efficiency calculations, selection of pumps for hydraulic power transmission. **5 Hours**

ACTUATORS: Linear & Rotary actuators, Hydraulic motors, - Types, vane, gear, axial piston, & radial piston. Types of cylinder & its mountings, calculations of piston velocity, thrust under static applications. Design consideration for cylinders, Intensifier.

6 Hours

UNIT - II

CONTROL OF FLUID POWER: Necessity of pressure control, directional control, flow control valves, **PRESSURE CONTROL VALVE** :Principle of pressure control valves, relief valves, pressure reducing valve, sequence valve, unloading valve, sequencing valve. **FLOW CONTROL VALVES:** Principle of operation, pressure compensated, temperature compensated flow control valves, **DIRECTION CONTROL VALVES :** Check valves, types

of D.C. Valves : Two way two position, four way three position, four way two position valves, open center, closed center, tandem center valves, method of actuation of valves, manually operated, solenoid operated, pilot operated etc**.**

7 Hours

DESIGN OF HYDRAULIC CIRCUITS: Introduction to hydraulic circuit. Single acting and double acting cylinder actuation circuit, Circuit illustrating use of different types of direction control valve, pressure control valve and flow control valve, regenerative circuit, synchronization circuit, safety circuit, Intensifier circuit.

ACCUMULATORS: Types & functions of accumulators, applications circuits.

8 Hours

UNIT – III

PNEUMATICS: Introduction to pneumatic power sources, Comparison of Pneumatics with Hydraulic power transmission, Basic structure, Air preparation units, Filter, Regulators & Lubricators. Actuators: linear and rotary actuators, air motors, pressure regulating valves. Directional control valves: two way, three way & four way, five way valves, seat type, check valve, solenoid operated, push button; & lever control valves. Flow control valves, logic valves, quick exhaust valve, time delay valve**.** Simple Pneumatic circuits.

9 Hours

Course Outcomes (CO):

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.

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,Second edition.
3. **Oil Hydraulic systems** – **Principles and Maintenance** - S.R. Majumdar, Tata McGraw Hill Publishing 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 - 2099.
2. **Fundamentals of Pneumatic Control Engineering** - J P Hasebrink & R Kobbler, Festo Didactic publication, 3PrdP edition – 2089.
3. **Pneumatic Control for Industrial Automation** - Peter Rohner & Gordon Smith, John Wiley Sons publication – 2089.
4. **Power Hydraulics** - Michael J Pinches & John G Ashby, Prentice Hall – 2089

Course Articulation Matrix:

Course Code / Name: 20MEE26/ Fluid Power Systems															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE26.1	2	3	1						1	1		1	3		
C-20MEE26.2	2	3	1						1	1		1	3		
C-20ME26.3	3	2	1						1	1		1	2		
C-20ME26.4	1	2	3						1	1		1	3		
C-20ME26.5	1	2	3						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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PLASTIC PART DESIGN & MANUFACTURING

Course Code	**20MEE27**	**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 about plastics and their processing.
2. Understand the design considerations in molding.
3. Observe and understand the various processes in a tool room.
4. Apply design concepts in various kinds of dies and die casting.
5. Study defects & identify solutions in die casting and die assembly techniques.

UNIT – I

Introduction: Plastics, advantages and disadvantages. Properties of plastics.
Thermoplastic Processing methods: Injection molding, extrusion, thermoforming, blow molding, roto molding.
Part requirements for Design: Mechanical, thermal, chemical, weather / environment, appearance, life expectancy, dimensional tolerances, processing, production quantities, cost, assembly, activity **7 Hours**
General Design Considerations: Wall thickness, draft angle, rib design, boss design, part radii, part text, undercuts, living hinges, gate position.
Injection Mold part defects and solutions: Brittleness, warped parts, flashing, burn marks, weak weld lines, sink or voids, part sticking, dimensional inconsistency
Part assembly Techniques: Fastening, press fits, snap fit.
Welding techniques: Induction, ultrasonic etc
Adhesive and solvent
Finishing of plastics: Electroplating, painting, surface treatment, machining

8 Hours

UNIT – II

Visit to tool-room: Die manufacturing & die assembly

Visit: Injection mold shop

Injection molding process, process parameters, defects & safety / hazards

8 Hours

(Reports of industry visits have to be submitted, evaluated for internal assessments)

Die casting Part Design and Manufacturing: Introduction, die casting, advantages of die casting, and properties of die casting alloys

Die casting process: Hot chamber die casting and cold chamber die casting
Design considerations for part: Machinability, corrosion and acid resistance, weight and cost, appearance, surface treatment, dimensional tolerances / stability, processing, production quantities, cost, assembly, activity
General Design Considerations: Wall thickness, draft angle, rib design, boss design, part radii, part text, undercuts, living hinges, gate position.

8 Hours

UNIT – III

Die Cast part defects and solutions: Brittleness, warped parts, flashing, weak weld lines, sink or voids, part sticking, dimensional inconsistency.
Part assembly Techniques: Fastening, press fit, other assembly techniques.
Finishing of Die cast parts: Electroplating, painting, surface treatment, machining,
Visit: Die casting shop: Die casting machine, die casting machine parameters, safety / hazard **8 Hours**

(Reports of industry visits have to be submitted, evaluated for internal assessments)

Course Outcomes (CO):

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

CO 1	Explain plastics and their processing.
CO 2	Explain design considerations in molding.
CO 3	Explain the processes observed in the tool room and present a report.
CO 4	Design various kinds of dies.
CO 5	Explain defects in die casting and generate solutions and understand the assembly techniques.

TEXTBOOKS:

1. Edward Magrab, —Integrated product and process design and Developmentǁ, CRC Press, 2009.
2. Corrodo Poli, —Design for Manufacturing: A structured approachǁ, Butterworth-Heinemann, 2001.
3. K G Cooper, —Rapid Prototyping Technologyǁ, Marcel Dekker, Inc. 2001

REFERENCE BOOK:

1. Lal G.K, Vijay Gupta, Venkata Reddy N, —Fundamentals of Design and Manufacturingǁ, Narosa Book Distributors Private Limited, 2010.

Course Articulation Matrix:

Course Code / Name : 20MEE27 / Plastic Part Design & Manufacturing															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE27.1			2	3		1	2		1				3		3
C-20MEE27.2		2	3		3	1	3						3		3
C-20MEE27.3		1	2				2			3			3		3
C-20MEE27.4		2	3	3	3	1	2						3		3
C-20MEE27.5		2	2	2		2	3			1			3		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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WIND AND SOLAR POWER ENGINEERING

Course Code	**20MEE31**	**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. 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 – I

PRINCIPLE OF SOLAR RADIATION

Solar Radiation - Empirical Equations - Solar Chart - Measurements of Solar Radiation and Sunshine - Solar

Radiation Data.

SOLAR THERMAL ENERGY CONVERSION

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**

UNIT – II

SOLAR PHOTO VOLTAICS

Introduction - Fundamentals of photo Voltaic Conversion - Solar Cells - PV Systems - PV Applications.

WIND ENERGY

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**

UNIT – III

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**

Course Outcomes (CO):

At the end of the course the 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.

TEXTBOOKS:

1. WS.P. Suknofme, " Solar Energy Principle of Thermal Collection and Storage ", (2097), Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
2. G.D.Rai, " Non Conventional Energy Sources ", (2099), Khanna Publishers, New Delhi.

REFERENCE BOOKS:

1. H.P.Garg and J.Prakash, " Solar Energy, Fundamentals and Applications " (2097), Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. B.S.Magal, " Solar Power Engineering " (2093), Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. J.R.Howell, R.B.Bannerot and G.C.Vtiet, " Solar Thermal Systems ", (2082), Tata Mc Graw
4. Hill Publishing Company Ltd., New Delhi.
5. J.A.Duffie and W.A.Beckman, " Solar Engineering of Thermal Process " (2091), John Wiley,New York.
6. Golding E.W. " The Generation of Electricity by Wind Power ", (2076), E and F N Spon Ltd., London.
7. Le Gourieres D., " Wind Power Plant, Theory and Design ", (2082), Pergamon Press, France.

Course Articulation Matrix:

Course Code / Name: 20MEE31/ Wind and Solar Power Engineering															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE31.1	1	2	3	0	0	1	1	1	1	1	0	0	0	2	0
C-20MEE31.2	3	1	1	0	0	1	1	1	1	1	0	0	0	2	0
C-20MEE31.3	3	2	1	0	0	1	1	1	1	1	0	0	0	2	0
C-20MEE31.4	3	2	0	0	0	1	1	1	1	1	0	0	0	2	0
C-20MEE31.5	1	2	3	0	0	1	1	1	1	1	0	0	2	0	0

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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COMPUTATIONAL FLUID DYNAMICS

Course Code	**20MEE32**	**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 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 – I

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.

10 Hours

GOVERNING 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.

CFD TECHNIQUES: Introduction, Discretization of governing equations, Finite difference method, Finite volume method, converting governing equations to algebraic equation system, Numerical solutions. **9 Hours**

UNIT – II

CFD SOLUTION ANALYSIS: Introduction, consistency, stability, convergence, accuracy, efficiency, case studies.

PRACTICAL GUIDELINES FOR CFD: Introduction, grid generation, boundary conditions, turbulent modeling. **9 Hours**

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. **8 Hours**

UNIT – III

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.

6 Hours

Course Outcomes (CO):

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.

TEXTBOOKS:

1. **Computational Fluid Dynamic – a practical approach,** Jiyuan Tu, Guan Heng Yeoh and Chaoqun Liu, Butterworth-Heinemann (ELSEVIER), 2008.
2. **Introduction to Computational Fluid Dynamics**, Pradip Niyogi, S.K. Chakrabarthy and M.K. Laha, Pearson Education, 2006.

REFERENCE BOOKS:

1. **An introduction to CFD,** H. Versteeg and W. Malalasekra, Pearson, Education, 2nd Edition, 2008.
2. **Introduction to Computational Fluid Dynamics,** Anil W. Date, Cambridge University press, 2007.
3. **Computational Fluid Dynamics – The basics and applications**, Anderson J.D. Jr, (2095), Mcgraw-Hill, New York.

Course Articulation Matrix:

Course Code / Name: 20MEE32/ Computational Fluid Dynamics															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE32.1	3	1	1					1	1				3	2	
C-20MEE32.2	1	3	2		1			1	1				3	2	
C-20MEE32.3	1	2	3					1	1				3	2	
C-20MEE32.4	3	1	1					1	1				3	2	
C-20MEE32.5	3	1	1		1			1	1				1	2	

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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REFRIGERATION AND AIR CONDITIONING

Course Code	**20MEE33**	**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 basic principles of refrigeration by relating it to refrigeration cycles.
2. Understand working of vapour compression and vapour absorption refrigerating system are understood.
3. Calculate the cooling loads in an Air conditioning system.
4. Design and analyze the ducts used in air conditioning systems.
5. Know balancing of components for refrigeration systems.

UNIT – I

Refrigeration: Principles, ideal cycle, Bel, Coleman and Boot strap air cycles, COP calculations. Refrigerants – ECO friendly refrigerants.

7 Hours

Vapour Compression System: Thermodynamic analysis, performance of system under varying operating conditions, cascade refrigeration, multistage refrigeration working principles. **5 Hours**

Vapour Absorption and Other Systems: Ammonia - water system, Lithium Bromide – water system. Use of enthalpy –concentration charts, steam jet refrigeration and solar refrigeration systems. **4 Hours**

UNIT - II

Air Conditioning: Psychrometry, psychrometer, psychometric processes, air conditioning cycles, cooling and reheat cycles, by-pass factor – humidification.

4 Hours

Cooling & Heating Load: Effective temperature, comfort conditions, sensible heat factor ratio, number of air changes, cooling/heating load calculations.

4 Hours

Duct Design and Air Distribution: Considerations, methods of duct design air distribution systems, fans and air conditioning systems control. **7 Hours**

UNIT – III

Balancing of Components: Condensers, air cooled, water cooled and evaporative condensers, selection, evaporates – flooded, dry expansion, shell and tube and double pipe, compressors – reciprocating, rotary and centrifugal types. Expansion devices, cooling towers. **8 Hours**

Course Outcomes (CO):	
At the end of the course the student will be able to	
CO 1	Explain the basic principles of refrigeration and methods of aircraft refrigeration. Solve problems related to mass flow rate of air, power requirement, cooling load and size of the compressor required.
CO 2	Explain the working of vapour compression and vapour absorption refrigerating systems. Calculate the performance parameters. .
CO 3	Explain psychrometry and air conditioning. Calculate the cooling loads/heating loads in an Air conditioning system.
CO 4	Explain the methods of duct design and types of fans used in air conditioning systems. Calculate duct dimensions and duct loss. Calculate fan speed, discharge, power and dimensions.
CO 5	Explain the construction and working of components for refrigeration systems

TEXTBOOK:

1. Manohar Prasad, —Refrigeration and Air Conditioning‖ Wiley Eastem Limited, 2083..

REFERENCE BOOKS:

1. Arora S.C. and Domkundwar S., —Refrigeration and Airconditioning‖, Dhanpat Rai and Sons, New Delhi, 2097.
2. Stocker, —Refrigeration and Air Conditioning', Tata McGraw Hill Publishing Company Ltd", 2081.
3. Roy J Dossat, —Principles of Refrigeration‖ S I Version, Wiley Easten Limited , 2085.
4. Sadhu Singh, —Refrigeration and Air Conditioning‖, Khanna Publishing House.
5. Domkundwar, —A Course in Refrigeration & Air Conditioning,‖ Dhanpat Rai publications.

Course Articulation Matrix:

Course Code / Name : 20MEE33 / Refrigeration and Air conditioning															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE33.1	2	3	1						1	1		1		2	
C-20MEE33.2	2	3	1						1	1		1		2	
C-20MEE33.3	1	3	2						1	1		1		3	
C-20MEE33.4	2	3	1						1	1		1		2	
C-20MEE33.5	3	1							1	1		1		2	

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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ENERGY MANAGEMENT

Course Code	**20MEE34**	**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 fossil fuel reserves in India, energy requirements in future, the need for energy conservation and management and energy conservation methods.
2. Understand pollution due to power plants, greenhouse effect, global warming.
3. Get the idea of energy auditing
4. Explain about heat recovery devices and energy storage systems and cogeneration concepts..
5. Understand various duties and responsibilities of energy manager and latest developments in energy management, role of BEE in India.

UNIT - I

Energy scenario

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

Energy conservation. Energy efficiency benefits, methods of energy conservation, simple energy conservation methods applicable to domestic, transport, agricultural and industrial sectors. **8 Hours**

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. **8 Hours**

UNIT - II

Assessment of boiler performance.
Assessment of furnace performance.
Efficient use of steam in distribution system **7 Hours**

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

Cogeneration: Concepts, Types of cogeneration systems. **7 Hours**

UNIT – III

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

Latest developments in energy management. Kyoto protocol, carbon trading, carbon fund, energy rating, green rating. **9 Hours**

Course Outcomes (CO):

At the end of the course the 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.

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 ,2081
2. Energy conservation in Process Industry—W.F.Kenny(2084)
3. Energy Engineering and Management- Amlan Chakrabarti-Prentice hall India 2011
4. Energy Management Principles C Smith-Pergamon Press, New York 2081
5. Bureau of energy efficiency Hand outs New Delhi

E-BOOK

Energy management handbook by Wayne C. Turner & Steve Doty. -- 6th ed. p. cm. ISBN: 0-88173-542-6 (print)

Course Articulation Matrix:

Course Code / Name: 20MEE34/ Energy Management															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE34.1	3	2				2	2	1	1	1		1	1	2	1
C-20MEE34.2	3	3				2	2	1	1	1		1	1	3	1
C-20MEE34.3	3	3				2	3	1	1	1		1	1	3	1
C-20MEE34.4	3	2				2	2	1	1	1		1	1	3	1
C-20MEE34.5	3	2				2	2	1	1	1		1	1	3	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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RENEWABLE SOURCES OF ENERGY

Course Code	**20MEE41**	**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 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
   i) solar energy
   ii) biomass energy
   iii) wind energy
   iv) geothermal energy
   v) ocean energy
   vi) tidal energy
   vii) wave energy
   viii) energy from fuel cells.

UNIT – I

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. **8 Hours**

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 **8 Hours**

UNIT – II

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 **4 Hours**

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. **4 Hours**

Tidal Power- Introduction, causes for tide formation, power of tide, numerical problems tidal power plants, advantages and limitations. **3 Hours**

Ocean Thermal Energy – Introduction to O.T.E.C., open and closed cycle OTEC systems, prospects in India. **2 Hours**

Wave Energy– Introduction, power of wave energy, numerical problems, and conversion devices. **3 Hours**

UNIT - III

Geothermal Energy- Introduction, types of geothermal resources, methods of harnessing, geothermal energy applications, environmental problems and prospects in India.

3 Hours

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 **4 Hours**

Course Outcomes (CO):	
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.

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. 2099
5. Energy Technology (Non Conventional& Conventional) by S. Rao, Dr. B.B.Parulekar Khanna Publishers, third edition 2013

Course Articulation Matrix:

Course Code / Name : 20MEE41 / RENEWABLE SOURCES OF ENERGY															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE41.1	2	3	-	-	-	1	2	-	1	1	-	1	-	2	-
C-20MEE41.2	2	3	-	-	-	1	2	-	1	1	-	1	-	2	-
C-20MEE41.3	2	3	-	-	-	1	2	-	1	1	-	1	-	3	-
C-20MEE41.4	2	3	-	-	-	1	2	-	1	1	-	1	-	2	-
C-20MEE41.5	3	1	-	-	-	1	2	-	1	1	-	1	-	2	-

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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POWER PLANT ENGINEERING

Course Code	**20MEE42**	**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 the idea and understand the steam power plant and its working
2. Know steam generation using high pressure boilers
3. Understand and explain diesel power plant and hydro power plant, its working
4. Know and understand gas turbine power plant and nuclear power plant its working
5. Understand and calculate power station estimation and its economics.

UNIT - I

Chapter-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

Chapter-2: Generation of steam using forced circulation, high and super critical pressures, a brief account of Benson and 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. **16 Hours**

UNIT – II

Chapter-1: 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.

Chapter-2: 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.

Chapter-3: Gas turbine Power Plant:

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

Chapter-4: Nuclear Power Plant

Principles of release of nuclear energy, fusion and fission reactions, nuclear fuels used in the reactors, Multiplication and thermal utilization factors, 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.

16 Hours

UNIT – III

Chapter-1: 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 units.

Chapter-2: Economics of power generation:

Cost of energy production, selection of plant and generating equipment and operating characteristics of power plants, tariffs for electrical energy. **(**Self-Study**)**

7 Hours

Course Outcomes (CO):	
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.

TEXTBOOKS:

Power plant Engineering, P.K.Nag Tata McGraw Hill,3PrdP Edition, 2007
Power plant Engineering by Domakundawar,Dhanpath Rai Sons,2005

REFERENCE BOOKS:

17TE-Book17T Power plant Engineering by R.K.Rajput. LaxmiPublication, New Delhi.2011
Principles of Energy conversion, A W.Culp Jr. McGraw Hill, 2PndP Edition,2096
Non-conventional Energy sources by G.D.Rai Khanna Publishers, 2011
Power Plant Engineering, S.C. Sharma, Khanna Publications

E-BOOKS:

1. Power plant Engineering P.K.Nag Tata McGraw Hill,3P[rd]P Edition, 2002
2. Power Plant Technology by M.M. EI-Wakil McGraw Hill,1 Edition

Course Articulation Matrix:

COURSE CODE / NAME: 20MEE42, Power Plant Engineering															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE42.1	3	-				1	1			1		1		3	
C-20MEE42.2	2	3				1	1			1		1		3	
C-20MEE42.3	2	3				1	1			1		1		3	
C-20MEE42.4	3	2				1	1			1		1		3	
C-20MEE42.5	2	2				1	2			1		2		2	

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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INTERNAL COMBUSTION ENGINES

Course Code	**20MEE43**	**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 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 fuels like LPG, Hydrogen & alcohols.
5. Summarize the recent developments in engine and Measurement of different engine parameters.

UNIT – I

SPARK IGNITION ENGINES:

Spark ignition Engine mixture requirements - Feedback Control Carburetors -Fuel - Injection systems - Monopoint and Multipoint injection - Stages of combustion - Normal and Abnormal combustion-Factors affecting knock - Combustion Chambers -.

7 Hours

COMPRESSION IGNITION ENGINES

States of combustion in C.I. Engine - Direct and indirect injection systems - Combustion chambers - Fuel spray behavior - spray structure, spray penetration and evaporation - Air motion – Turbocharging. **7 Hours**

UNIT – II

POLLUTANT FORMATION CONTROL:

Pollutant - Sources and types - formation of NOx - Hydro-carbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions –

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

9 Hours

ALTERNATIVE FUELS

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

9 Hours

UNIT - III

RECENT TRENDS

Learn 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

Course Outcomes (CO):	
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.

TEXTBOOKS:

1. John B. Heywood, —Internal Combustion Engine Fundamentals ", McGraw Hill, 2088.
2. Charles Fayette Taylor ,The Internal-combustion Engine in Theory and Practice, MIT PRESS Massachusetts Institute of Technology

REFERENCE BOOKS:

1. M.L Mathur and R.P.Sharma, — Internal Combustion Engine‖. Dhanpat Rai
2. Rowland S.Benson and N.D.Whitehouse, — Internal combustion Engines —, Vol.I and II, Pergamon Press, 2083.
3. Duffy Smith, —Auto fuel Systems —, the Good Heart Willox Company, Inc., 2087.
4. Ryan O Hayre, Suk – Woncha, Whitney colella, Fritz B. Prinz, —Fuel Cell Fundamentals‖, Second Edition, John Wiley Publication,2009.

Course Articulation Matrix:

Course Code / Name : 20MEE43 / Internal Combustion Engines															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE43.1	3	2				1	1		1			1		2	
C-20MEE43.2	3	2				1	1		1			1		2	
C-20MEE43.3	3	2				1	1		1			1		2	2
C-20MEE43.4	3	2				1	1		1			1		2	2
C-20MEE43.5	3	2				1	1		1			1	2		2

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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CAD / CAM			
Course Code	**20MEE51**	**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. 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 – I

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.

17 Hours

UNIT – II

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**

UNIT – III

Group Technology & Flexible Manufacturing: Part families, Part Classification & coding, Machine cell design & benefit of GT, FMS work stations, planning the FMS, FMS layout configuration. Analysis method, application and benefit of FMS. Shop floor control, Functions, Shop floor control system. **7 Hours**

Course Outcomes (CO):

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).
CO 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.

TEXTBOOKS :

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. (2077) "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** (2098) —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.** (2086) —Industrial Robotics Technology, Programming and Applications‖ McGraw-Hill Inc, Singapore.
5. **Mechatronics,** HMT Ltd., Tata MaGraw Hill Pub.200.
6. Vince, John (2004), Introduction to Virtual Reality Authors: Vince, Springer-Verlag London

MOOC/NPTEL Resources:

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

Course Articulation Matrix:

Course Code / Name : 20MEE51 / CAD/CAM															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE51.1	1	1	-	-	2	-	-	1	2	1	-	1	1	-	2
C-20MEE51.2	2	3	1	2	2	-	-	1	2	1	-	1	2	-	2
C-20MEE51.3	1	3	2	2	2	-	-	1	2	2	-	1	2	-	2
C-20MEE51.4	2	2	2	2	3	-	-	1	3	2	-	1	1	-	3
C-20MEE51.5	2	2	2	2	2	-	-	1	2	2	-	1	1	-	2

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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WELDING TECHNOLOGY

(Industry offered Elective Course with IWS support)

Course Code	**20MEE52**	**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. Explain the working principles and process parameters of welding technology and explain the parts, mechanisms and working of conventional various welding processes.
1. Suggest suitable solutions to metallurgical issues and Weldability of various metals.
2. Suggest suitable testing aspects of welding in both destructive testing, non-destructive testing.
3. Select suitable welding and expert systems in welding. and select suitable welding codes to the welding code.
4. Suggest suitable precautions for electrical safety, fire hazards.

UNIT – I

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, resistance welding process

Advanced welding process: Plasma welding, cutting, 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**

UNIT - II

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

UNIT - III

Developments and applications in welding Technology

Welding application to pressure vessel, structures, ship building, 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**.** **9 Hours**

Course Outcomes (CO):

At the end of the course the student will be able to	
CO 1	Describe the principles of conventional welding processes. Demonstrate the set-up and operation in arc welding processes such as SMAW, GMAW and TIG.
CO 2	Describe the principles of advanced welding processes such as plasma welding, electron beam welding, laser welding. Identify metallurgical issues associated with welding.
CO 3	Describe methods of Destructive and Non Destructive testing and apply LPI and UTI in weld joint, Inspection & testing.
CO 4	Describe the procedures related to welding joint design, welding distortion and residual stress.
CO 5	Describe welding application areas and health & safety issues in automobile, power plants and shipbuilding sectors

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 : 20MEE52 / WELDING TECHNOLOGY															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE52.1	2	3	0	1	1	0	1	1	2	1	0	1			2
C-20MEE52.2	3	2	0	1	0	0	1	1	1	1	0	1			1
C-20MEE52.3	3	2	1	1	1	0	1	1	2	1	0	1			1
C-20MEE52.4	3	2	2	1	0	0	1	1	2	1	1	1			2
C-20MEE52.5	3	2	1	1	1	1	1	2	2	1	2	2			2

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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COMPUTER INTEGRATED MANUFACTURING

Course Code	**20MEE54**	**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 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 – I

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.

9 Hours

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.

8 Hours

UNIT - II

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

9 Hours

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.

7 Hours

UNIT – III

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

06 Hours

Course Outcomes (CO):	
At the end of the course the student will be able to	
CO 1	Discuss various types of automation and production concepts
CO 2	Distinguish various automated flow lines in high volume production systems.
CO 3	Analyze and Design appropriate automated assembly systems.
CO 4	Discuss various types of inspection and material transfer system
CO 5	Illustrate the working principle of the material transfer systems.

TEXTBOOKS:

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

REFERENCE BOOKS:

1. CAD/CAM Principles and Applications, Rao P.N. Tata McGraw Hill, Second Edition, 2004.
2. Principles of Computer Integrated Manufacturing- Vajpayee S.Kant. Prentice Hall of India, New Delhi,2099.

Course Articulation Matrix:

Course Code / Name : 20MEE54 / Computer Integrated Manufacturing															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE54.1	2	2	2	1	1	0	0	0	0	0	0	1	3	0	1
C-20MEE54.2	3	3	3	2	1	0	0	0	3	3	0	1	3	0	1
C-20MEE54.3	3	2	3	2	1	0	0	0	3	3	0	1	2	0	2
C-20MEE54.4	2	2	2	1	1	0	0	0	0	0	0	1	3	0	1
C-20MEE54.5	2	2	2	1	1	0	0	0	0	0	0	1	3	0	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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METAL FORMING THEORY & PRACTICE

Course Code	**20MEE55**	**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 various characteristics of wrought products and stresses induced in wrought products.
2. Apply forging calculations for various forging products and to know about the concepts of rolling.
3. Understand the concepts of extrusion and drawing.
4. Understand various sheet metal forming and stretch forming processes.
5. Discuss and understand about powder metallurgy.

UNIT – I

INTRODUCTION AND CONCEPTS: Classification of metal working processes, characteristics of wrought products, advantages and limitations of metal working processes. Concepts of true stress, true strain, triaxial & biaxial stresses. Determination of flow stress. Principal stresses, Tresca & Von-Mises yield criteria, concepts of plane stress & plane strain. **Effects of parameters:** Temperature, strain rate, friction and lubrication, hydrostatic pressure in metalworking, Deformation zone geometry, workability of materials, Residual stresses in wrought products.

14 Hours

UNIT – II

Forging process - classification - equipment calculation of forging loads - forging defects - residual stresses. Rolling: classification -rolling mills - rolling of bars & shapes - rolling forces - analysis of rolling - defects in rolling- theories of hot & cold rolling - torque power estimation. Extrusion: classification-equipment - Analysis of extrusion process-extrusion defects - hydrostatic extrusion - tube extrusion. Drawing: Classification - rod & wilt drawing equipment - analysis. Deep drawing - tube drawing - analysis, residual stresses.

14 Hours

UNIT - III

Sheet metal forming - methods - shearing and blanking bending - stretch forming - deep drawing - forming limit criteria - defects. Stretch forming - press brake forming - explosive forming - electro hydraulic forming magnetic pulse forming - super plastic forming - electro forming - fine blanking PIM forging-Isothermal forging –HERF.

Powder metallurgy: Basic steps in Powder metallurgy brief description of methods of production of metal powders, conditioning and blending powders, compaction and sintering application of powder metallurgy components, advantages and limitations.

08 Hours

Course Outcomes (CO):	
At the end of the course the student will be able to	
CO 1	Know the various characteristics of wrought products and stresses induced.
CO 2	Perform calculations for various forging products and to know about the concepts of rolling.
CO 3	Explain the concepts of extrusion and drawing.
CO 4	Distinguish between various sheet metal forming and stretch forming processes.
CO 5	Elaborate about powder metallurgy.

TEXTBOOKS:

1. **Mechanical metallurgy (SI units),** by G.E. Dieter, Mc Graw Hill pub.2001
2. **Manufacturing Engineering and Technology** by Serope Kalpakjian and Stevan R.

REFERENCE BOOKS:

1. **Materials and Processes in Manufacturing** by E.paul, Degramo, J.T. Black, Ronald, A.K. Prentice –Hall of India 2002
2. **Principles of Industrial metal working process** – G.W. Rowe, CBSpub. 2002
3. **Manufacturing Science,** By Amitabha Ghosh & A.K. Malik – East –Westpress 2001
4. **Theory of plasticity by Dr. Sadhu Sing**

Course Articulation Matrix:

Course Code / Name :20MEE55/ METAL FORMING THEORY & PRACTICE															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE55.1	3	1	1	-	-	-	1	-	1	1	-	1	-	-	3
C-20MEE55.2	3	1	1	-	-	-	1	1	1	1	-	1	-	-	3
C-20MEE55.3	3	1	1	-	-	-	1	1	1	1	-	1	-	-	3
C-20MEE55.4	3	1	1	-	-	-	1	1	1	1	-	1	-	-	3
C-20MEE55.5	3	1	1	-	-	-	1	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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NON-TRADITIONAL MACHINING

Course Code	**20MEE61**	**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 about non-traditional machining process, its need and importance in manufacturing. To machine hard and tough materials by using thermo-electric energy like plasma, laser and electron beam.
2. Machine brittle and soft materials by applying mechanical energy using abrasives in combination of ultrasonic energy or pressurised fluids like gas and liquids.
3. Fabricate tools and dies which are made-up of hard materials using electric discharge energy.
4. Get an idea of how electro-chemical energy is used to machine hard, tough and brittle materials with high metal removal rate.
5. Know how chemicals are used in machining complex part profiles by chemical blanking and chemical milling.

UNIT – I

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.

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 & Equipments, Process Characteristics, Application, Advantages & Limitations.

15 Hours

UNIT – II

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.

CHEMICAL MACHINING (CHM): Introduction, CHM Technique, Classification, Masking. Chemical Blanking: Process steps, Process Characteristics, Applications, advantages & Limitations.

Chemical Milling: Process steps, Process Characteristics, Applications, advantages & Limitations.

14 Hours

UNIT – III

ULTRASONIC, MACHINING (USM): Introduction, Machining Principle & Equipments used, Tools of USM- Tool material, Tool Size & Design of tool, Abrasives of USM- Purpose of abrasives, Abrasive materials, Selection of abrasives, Transducers, Process Characteristics, Application, Advantages & Limitations.

ABRASIVE JET MACHINING (AJM): Introduction, Machining Principle and equipments used, Elements of the Process, Process Characteristics, Application, advantages & Limitations.

Water Jet Machining Process (WJM): Introduction, Machining Principle and equipments used, Process Details, Applications, advantages & Limitations.

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.

10 Hours

Course Outcomes (CO):	
At the end of the course the student will be able to	
CO 1	Compare with conventional machining processes, choose the suitable non-conventional process and discuss its applications.
CO 2	Explain the construction and working principle of Plasma Arc (PAM), Laser Beam (LBM) and Electron Beam machining process (EBM) and also discuss the Advantages, Disadvantages & Applications.
CO 3	Explain the construction and working principle of Electrochemical (ECM) and also discuss the different types of ECM with Advantages, Disadvantages & Applications.
CO 4	Explain the construction and working principle of Chemical Machining (CM) and also discuss the different types of CM with Advantages, Disadvantages & Applications.
CO 5	Explain the construction and working principle of Electric Discharge(EDM) and also discuss the different types of EDM with Advantages, Disadvantages & Applications. Explain about USM, AJM and WJM in terms of its principle, construction, working, advantages, disadvantages and applications.

TEXTBOOKS:

1. Modern machining process, Pandey and Shah, Tata McGraw Hill 2000.
2. Production Technology: HMT Tata McGraw Hill 2001.

REFERENCE BOOKS:

1. Advanced Machining process, V.K Jain,2007.
2. New Technology, Bhattacharya 2000.
3. Modern Machining Process, Aditya 2002.
4. Non-Conventional Machining, P.K. Mishra, The Institution of Engineers (India) Test book series, Narosa Publishing House 2005.
5. Metals Handbook: Machining- Volume 16.
6. Nontraditional Machining Processes, E. Weller, Society of Manufacturing, 2 Sub edition (2084).

Course Articulation Matrix:

Course Code / Name :20MEE61/ Non-Traditional Machining															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE61.1	3	1	1	-	-	-	1	-	1	1	-	1	-	-	3
C-20MEE61.2	3	1	1	-	-	-	1	1	1	1	-	1	-	-	3
C-20MEE61.3	3	1	1	-	-	-	1	1	1	1	-	1	-	-	3
C-20MEE61.4	3	1	1	-	-	-	1	1	1	1	-	1	-	-	3
C-20MEE61.5	3	1	1	-	-	-	1	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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FOUNDRY TECHNOLOGY

Course Code	**20MEE63**	**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 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 – I

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.

8 Hours

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.

8 Hours

UNIT - II

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.

8 Hours

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.

8 Hours

UNIT – III

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

Course Outcomes (CO):	
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.

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

Course Articulation Matrix:

Course Code / Name : 20MEE63 / Foundry Technology															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE63.1	3	1	0	0	0	0	0	0	0	0	0	0	1	1	3
C-20MEE63.2	3	3	2	0	0	0	0	0	0	0	0	0	0	0	3
C-20MEE63.3	3	2	2	0	0	0	0	0	0	0	0	0	1	0	3
C-20MEE63.4	3	1	1	0	0	0	0	0	0	0	0	0	0	0	3
C-20MEE63.5	3	1	3	0	0	1	0	0	0	0	0	0	0	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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COMPOSITE MATERIALS TECHNOLOGY

Course Code	**20MEE64**	**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 basics and types of composite materials.
2. Know the procedures to manufacture metal and ceramic matrix composites.
3. Understand the basics of bag and compression molding.
4. Understand basics of composite design and equipments in composites design.
5. Understand the basics of mechanical properties of composite materials.

UNIT – I

INTRODUCTION

Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites. Applications, future potential of composites.

METAL MATRIX COMPOSITES: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC's and its application.

FABRICATION PROCESS FOR MMC'S: Powder metallurgy technique, liquid metallurgy technique, diffusion bonding, squeeze technique and secondary processing.

13 Hours

UNIT – II

FABRICATION: Fabrication of Composites, cutting, machining, drilling. Joints Design, Functionally Graded Materials.

MICRO MECHANICAL ANALYSIS OF A LAMINA: Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems.

MACRO MECHANICS Hooke's law for different types of materials, Number of elastic constants, Two – dimensional relationship of compliance and stiffness matrix.

MACRO MECHANICS OF A LAMINA: Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.

16 Hours

UNIT – III

MANUFACTURING: Lay up and curing, fabricating process, open and closed mould process, hand lay up techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermoforming, injection molding, blow molding.

TESTING: Quality inspection non-destructive testing. **10 Hours**

Course Outcomes (CO):

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

CO 1	Understand the classification of composite materials and their various applications.
CO 2	Demonstrate various manufacturing processes adopted for composite materials.
CO 3	Understand the micro and macro mechanics of composite lamina and the theories of failure applicable to composite materials.
CO 4	Understand the macro mechanics of Laminates
CO 5	Demonstrate the metal matrix composites and their manufacturing.

TEXTBOOKS:

1. Ronald Gibson, —Principles of Composite Material Mechanics ", Tata McGraw Hill, 2094.
2. Micael hyer, " Stress Analysis of Fiber - Reinforced Composite Materials ", Tata McGraw Hill, 2098.

REFERENCE BOOKS:

1. P.K.Mallicak, " Fiber-reinforced composites ", Monal Deklar Inc., New York, 2088.
2. B.D. Agarwal and L.J.Broutman, " Analysis and Performance of Fiber Composites ", John Wiley and Sons, New York, 2080.
3. F.L.Matthews & R.D.Rawlings, " Composite Materials, Engineering and Sciences ", Chapman & hall, London.

Course Articulation Matrix:

Course Code / Name: 20MEE64/ Composite Materials Technology															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE64.1	2	1		1	1	1	1	1				1	2		1
C-20MEE64.2	2	1	1	1	1	1	1	1				1	2		1
C-20MEE64.3	2	1	1	1	1	1	1	1				1	2		1
C-20MEE64.4	2	1	2	1		1	1	1				1	2		1
C-20MEE64.5	3	2	2	2								1	2		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 DESTRUCTIVE TESTING

Course Code	**20MEE65**	**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 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, Xero-radiography 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 – I

Introduction to Non Destructive Testing, Selection of ND methods, Visual Inspection, Leak testing – brief introduction, Liquid Penetrant Inspection – principle, advantages, limitations and applications, Magnetic Particle Inspection – methods of generating magnetic fields, types of magnetic particles, suspension liquids, steps in inspection, advantages, limitations and applications.

8 Hours

Eddy Current Inspection – principle, operation, operating variables, procedure, inspection coils, detectable discontinuities, advantages and limitations.

Industrial Computed Tomography – basic principles, capabilities and comparison with other NDT methods, applications

Thermal inspection – principles, equipment, inspection methods, applications.

8 Hours

UNIT – II

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

units, inspection standards

8 Hours

Radiographic Inspection – principles, limitations, radiation sources – X rays, γ rays, recording media, film types and selection, interpretation of radiographs, image quality, penetrameters

Electron radiography, Neutron radiography, Xero-radiography, application of radiographic inspection in industry .

8 Hours

UNIT – III

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.

7 Hours

Course Outcomes (CO):

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

CO1	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
CO2	Describe the principles of Eddy Current Inspection, Computed Tomography and Thermal inspection understanding its various applications
CO3	Illustrate the principle of Ultrasonic Inspection technique, set-up and operation. Demonstrate the benefits of UT over other techniques for a given sample
CO4	Illustrate the principles of Radiographic Inspection, Electron radiography, Neutron radiography, Xero-radiography and their applications. Interpet the radiography results of a given film of samples
CO5	Describe the principles of Acoustic Emission Inspection and analyse benefits and applications

TEXTBOOKS:

1. NDE and Quality Control, Vo.17, ASM Hand book, 9th Edition, 2089.
2. Practical Non-Destructive Testing, Baldev Raj, T.Jayakumar, M.Thavasimuthu, Narosa Publishers.
3. Non Destructive Test and Evaluation of Materials, J.Prasad and C G K Nair, Tata McGraw Hill.

Course Articulation Matrix:

Course Code / Name: 20MEE65/ Non Destructive Testing															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE65.1	1	2	3	1	0	0	1	0	1	2	0	1	3	2	
C-20MEE65.2	1	2	3	0	0	0	0	0	1	1	0	1	3	3	
C-20MEE65.3	1	2	3	1	1	0	0	0	1	2	0	1	2	3	
C-20MEE65.4	3	2	1	1	1	0	1	0	1	2	0	1	3	3	
C-20MEE65.5	3	2	0	0	0	0	0	0	1	0	0	1	3	2	

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	**20MEE71**	**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.

TEXTBOOKS:

1. Essentials of Human Resource Management & Industrial Relations-P Subba Rao, Third Revised Edition
2. Human Resource Management - John M. Ivancevich, 10/e, McGraw Hill.
3. Human Resource Management-Flippo
4. Human Resource Management - Lawrence S. Kleeman, Biztantra , 2012.
5. 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 : 20MEE71 / Human Resource Management															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE71.1	2	-	-	-	-	-	-	-	1	1	-	1	-	-	1
C-20MEE71.2	2	-	-	-	-	-	-	-	1	1	-	1	-	-	1
C-20MEE71.3	2	-	-	-	-	-	-	-	1	1	-	1	-	-	1
C-20MEE71.4	2	-	-	-	-	-	-	-	1	1	-	1	-	-	1
C-20MEE71.5	2	-	-	-	-	-	-	-	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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MARKETING MANAGEMENT

Course Code	**20MEE72**	**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-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 - 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 in retailing. **7 Hours**

Course Outcomes (CO):

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

TEXTBOOK:

1. Govindarajan. M. 'Modern Marketing Management', Narosa Publishing House, New Delhi, 2099.

REFERENCE BOOKS:

1. Philip Kolter, " Marketing Management: Analysis, Planning, Implementation and Control ", 2098.
2. Green Paul.E. and Donald Tull, " Research for Marketing Decisions ", 2075.
3. Ramaswamy.V.S. and S.Namakumari, " Marketing Environment: Planning, Implementation and Control the Indian Context ", 2090
4. Jean Plerre Jannet Hubert D Hennessey Global Marketing Strategies.

Course Articulation Matrix:

Course Code / Name: 20MEE72/ Marketing Management															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE72.1	3						1	1	1	1					
C-20MEEE2.2	3						1	1	1	1			1		1
C-20MEE72.3	3						1	1	1	1	2		1		1
C-20MEE72.4	2	3					1	1	1	1			1		1
C-20MEE72.5	3						1	1	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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TOTAL QUALITY MANAGEMENT

Course Code	**20MEE73**	**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 meaning of quality and the development of quality terminology and explain the principles of TQM.
2. Compute mean, median, mode and standard deviation and calculate area under the normal distribution and relate it to the quality concept.
3. Compute control limits for a variable chart and draw the X bar and R chart limits for attribute chart and draw p, np, c and u charts.
4. Explain the Acceptance Sampling plans and understand the concept of Design of Experiments.

UNIT – I

Introduction: The Meaning of Quality and Quality Improvement; Statistical Methods for Quality Control and Improvement; **TOTAL Quality Management:** Definition, Principles of TQM, Gurus of TQM, Benefits of TQM. **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).

17 Hours

UNIT - II

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

Process Capability: The foundation of process capability, Natural Tolerance limits, c_p – process capability index, c_{pk}, p_p – process performance index, summary of process measures. Numerical problems.

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

16 Hours

UNIT – III

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

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

6 Hours

Course Outcomes (CO):

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

CO 1	Describe the concept of quality and its evolution over the years; Describe the concept and principles of TQM.
CO 2	Describe fundamentals of statistics and 7 Quality Control tools. Solve problems related to descriptive statistics concerning a manufacturing firm
CO 3	Draw and analyze control charts for variables
CO 4	Draw and analyze control charts for attributes
CO 5	Describe the basic concepts of Acceptance Sampling and Design of experiments. Determine probability of accepting the submitted lot.

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, 2087
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. **NPTEL course material on Design of Experiments.**

Course Articulation Matrix:

Course Code / Name : 20MEE73 / Total Quality Management															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE73.1	3	1							1	1		1			2
C-20MEE73.2	1	3							1	1		1			3
C-20MEE73.3	1	3							1	1		1			3
C-20MEE73.4	1	3							1	1		1			3
C-20MEE73.5	3	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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OPERATIONS MANAGEMENT

Course Code	**20MEE74**	**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 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 – I

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

UNIT – II

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

UNIT – III

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

Course Outcomes (CO):

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.

TEXTBOOKS :

1. Production and Operations Management, William J Stevenson, Tata McGraw Hill, 8thEdition. 2011
2. Operations Management-Theory and Practice, B Mahadevan, Pearson Education, 2007.

REFERENCE BOOKS :

1. Production and Operations Management, Norman Gaither & Greg Frazier,
2. Operations Management for Competitive Advantage, R.B.Chase, NJ.Aquilino, F. Roberts Jacob; McGrawHill Companies Inc., Ninth Edition.
3. Production & Operations Management, Everett E.Adams, Ronald J.Ebert, Prentice Hall of India Publications, Fourth Edition.
4. Production / Operations Management, Joseph G Monks, McGraw Hill Books, 2001
5. Production / Operations Management, R. Pannerselvam, PHI India, 2011
6. Industrial Engineering & Operations Management, SK Sharma, Sk Kataria & Sons, 2002.

Course Articulation Matrix:

Course Code / Name : 20MEE74 / Operations Management															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-18MEE74.1	2	2	3	-	-	-	-	-	-	-	2	-	-	-	1
C-20MEE74.2	3	2	2	-	-	-	-	-	-	-	2	-	-	-	1
C-20MEE74.3	1	2	3	-	-	-	-	-	-	-	2	-	-	-	2
C-20MEE74.4	2	3	2	-	-	-	-	-	-	-	2	-	-	-	2
C-20MEE74.5	2	2	3	-	-	1	2	1	-	-	2	-	-	-	2

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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MAINTENANCE & RELIABILITY ENGINEERING

Course Code	**20MEE75**	**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 different types of maintenance done.
2. Develop interest in maintenance planning and control over maintenance.
3. Understand the cost analysis involved during maintenance.
4. Gain knowledge on reliability engineering.
5. Present importance of reliability and its implementation in mechanical applications.

UNIT – I

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.

17 Hours

UNIT – II

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, hazard identification techniques, some important distributions Numerical problems required.

14 Hours

UNIT – III

System Reliability - introduction, series, parallel, mixed configuration, series-parallel, parallel-series configurations, and 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. **8 Hours**

Course Outcomes (CO):

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

CO 1	Explain engineering fundamentals to different types of maintenance and basics of condition monitoring
CO 2	Describe maintenance planning and scheduling along with manpower planning to manage projects in multidisciplinary environments.
CO 3	Analyze the components of a mechanical system using reliability centered maintenance. Explain total productive maintenance.
CO 4	Explain the impact of reliability and failure models and hazard models.
CO 5	Describe system reliability and reliability improvement methods

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, 2085.
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, 2085.
2. Management of Industrial Maintenance by Kelley A., and Harris, M.J., Newnes-Butter worth.
3. Maintenance Engineering Handbook by Morrow, 2002.
4. Reliability Engineering, E. Balaguruswamy, Tata McGaw Hill
5. Industrial Maintenance Management, S.K. Srivastava, S.Chand & Co.

Course Articulation Matrix:

Course Code / Name: 20MEE75 / Maintenance & Reliability Engineering															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE75.1	1	3	2						1	1		1			1
C-20MEE75.2	1	2							2	2		1			
C-20MEE75.3	1	3	2			1			1	1		1			2
C-20MEE75.4	1	3							1	1		1			
C-20MEE75.5	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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ENGINEERING ECONOMICS

Course Code	**20MEE76**	**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. Analyse the time value of money.
2. Evaluate the worth of creations, by comparing the alternatives visa, vis the cost (cost-benefit analysis)
3. Take decisions with the limited resources, the relevant course of action, with the help of suitable tools.
4. Determine the cost involved in each operations, a product should undergo with an aim to fix suitable selling price for the product
5. Know the different terminology of Economics and to prepare ledgers, journals, balance sheets and profit and loss accounts.

UNIT – I

Fundamental economic concepts **7 Hours**

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

Interest **8 Hours**

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

UNIT – II

Economic Analysis of Alternatives **8 Hours**

Analysis based on: Present Worth [equal life and unequal life situations], Future Worth, Payback Period, Capitalized Worth, Equivalent Annual Worth, Exercises.

Rate of Returns **3 Hours**

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

Depreciation **4 Hours**

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

UNIT – III

Estimating and Costing **5 Hours**

Components of cost [Material cost, Labour cost, Overhead expenses, Prime cost, Factory cost, Total cost], Determination of selling price of a product, Exercises.

Mensuration, Machine shop calculations, Forging shop calculations, Exercises

4 Hours

Financial management

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

Course Outcomes (co):

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

CO 1	Explain the fundamental economic concepts.
CO 2	Use simple interest and compound interest to determine compounded and discounted amount.
CO 3	Compare the alternatives using Present Worth, Equivalent Annual Worth and Future Worth methods.
CO 4	Compare the alternatives using Internal Rate of Return methods and calculate the depreciated amount of a given assets using Straight line, Declining balance, Double declining g balance, Sum of year digit method and Sinking fund method.
CO 5	Estimate the selling price of given product and prepare balance sheet and profit-loss account for given data of a firm.

TEXTBOOKS:

1 Engineering Economics, Riggs J.L.,4th edition, Tata McGraw-Hill, 2004

2 Mechanical Estimating and Costing, Banga and Sharma, 16th edition, Khanna Publishers, 2012

REFERENCE BOOKS:

1 Engineering Economy, E Paul Degarmo, Macmillan Publishing, 2001

2 Engineering Economy, Gerald J Thuesen & W J Fabrycky, Prentice Hall of India, 9th ed.

3 Engineering Economics, Tarachand, Nemchand & Bros, 2096

4 Financial Management, I M Pandey, Vikas Publishing House, 2002

MOOC/NPTEL Resources:

1 http://nptel.ac.in/courses/112107209/

COURSE ARTICULATION MATRIX:

Course Code / Name : 20MEE76 / Engineering Economics															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE76.1	3	1				1			1	1		1			2
C-20MEE76.2	2	3				1			1	1		1			2
C-20MEE76.3	2	3				1			1	1		1			2
C-20MEE76.4	2	3				1			1	1		1			2
C-20MEE76.5	2	3				1			1	1		1			2

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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SUPPLY CHAIN AND LOGISTIC MANAGEMENT

Course Code	**20MEE81**	**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 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 – I

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

UNIT – II

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 leversto improve supply chain profitability.

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

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

UNIT – III

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

Course Outcomes (CO):

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.

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 - ThomsonLearning – ISBN 0-534-37363. -2002.
3. **Designing & Managing the Supply Chain** -David Simchi Levi, PhilipKaminsky & Edith Simchi Levi - Mc Graw Hill.
4. S**upply Chain and Logistics Management** – Upendra Kachuru

Course Articulation Matrix:

Course Code / Name: 20MEE81/organizational behavior															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE81.1	3	1				1	1				1				1
C-20MEE81.2	3	1				1	1				1				1
C-20MEE81.3	3	1				1	1				1				1
C-20MEE81.4	3	1				1	1				1				1
C-20MEE81.5	3	1				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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ORGANIZATIONAL BEHAVIOR

Course Code	**20MEE82**	**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 basics of organizational behavior.
2. Understand various learning theories and perception.
3. Understand the theories of motivation and know about groups.
4. Students must be able to apply the concepts of stress management which includes job rotation and reengineering work process.
5. Students will know the importance of communication and rules of effective communication.

UNIT – I

INTRODUCTION: Definition of Organization Behaviour and Historical development, Environmental context (Information Technology and Globalization, Diversity and Ethics, Design and Cultural, Reward Systems). THE INDIVIDUAL: Foundations of individual behaviour, individual differences. Ability. Attitude, Aptitude, interests. Values.

LEARNING: Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social learning theory, continuous and intermittent reinforcement.

PERCEPTION: Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect. **15 Hours**

UNIT – II

MOTIVATION: Maslow's Hierarchy of Needs theory, Mc-Gregor's theory X and Y, Hertzberg's motivation Hygiene theory, David Mc-Clelland's three needs theory, Victor Vroom's expectancy theory of motivation. THE GROUPS: Definition and classification of

groups, Factors affecting group formation, stages of group development, Norms, Hawthorne studies, group processes, group tasks, group decision making.

CONFLICT & STRESS MANAGEMENT: Definition of conflict, functional and dysfunctional conflict, stages of conflict process. Sources of stress, fatigue and its impact on productivity. Job satisfaction, job rotation, enrichment, job enlargement and reengineering work process. **15 Hours**

UNIT – III

PRINCIPLES OF COMMUNICATION: Useful definitions, communication principles, communication system, role of communication in management, barriers in communication, how to overcome the barriers, rule of effective communication.

9 Hours

Course Outcomes (CO):

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

CO 1	Explain the basics of organizational behavior Ability. Attitude, Aptitude, interests Values.
CO 2	Discuss various learning theories and perception.
CO 3	Explain the theories of motivation and know about groups.
CO 4	Discuss the concepts of stress management. Explain job rotation and reengineering work process.
CO 5	Explain the importance of communication and rules of effective communication.

TEXTBOOKS :

1. **Organizational Behaviour,** Stephen P Robbins, 9th Edition, Pearson Education Publications, ISBN-81-7808-561-5 2002
2. **Organizational Behaviour,** Fred Luthans, 9th Edition, Mc Graw Hill International Edition, ISBN-0-07-120412-12002

REFERENCE BOOKS :

1. Prentice Hall India, 2001
2. **Organizational Behaviour,** Aswathappa - Himalaya Publishers. 2001
3. **Organizational Behaviour,** VSP Rao and others, Konark Publishers.2002
4. **Organizational Behaviour,** (Human behaviour at work) 9th Edition, John Newstron/ Keith Davis. 2002

Course Articulation Matrix:

Course Code / Name: 20MEE82/organizational behavior															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE82.1	-	-	1	1	-	-	-	3	2	3	1	2			2
C-20MEE82.2	-	-	1	2	-	-	-	2	2	3	1	2			3
C-20MEE82.3	-	-	2	2	-	-	-	3	2	2	1	2			2
C-20MEE82.4	-	-	1	1	-	-	-	3	2	3	1	1			2
C-20MEE82.5	-	-	2	1	-	-	-	2	1	3	1	2			2

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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MANAGEMENT INFORMATION SYSTEM

Course Code	**20MEE83**	**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 basics of business information systems.
2. Discuss the various available information technologies and know both hardware and software applications.
3. Understand the basics of data resource management and business applications.
4. Understand and apply the concept of e-business.
5. Understand various management challenges and managing global systems.

UNIT – I

FOUNDATION CONCEPTS: Foundations of Information Systems in Business Information System and Technologies, Business applications, developments and management, competing with Information Technology using Information Technology for strategic advantage**.**

REVIEW OF INFORMATION TECHNOLOGIES: Computer Hardware – computer systems, end user and enterprise computing, computer peripherals, input, output, and storage

technologies, Computer Software- application software, end user application, system software, computer system management.

14 Hours

UNIT – II

DATA RESOURCE MANAGEMENT: Managing Data Resources, Technical foundations of Database Management, Telecommunication and Networks – overview of telecommunications and networks, technical telecommunications alternatives.

BUSINESS APPLICATIONS: The Internet worked E. business Enterprise, The Internet, Intranets and Extranets in Business, Enterprises Communication and Collaboration, Electronic Business Systems, Cross Functional E-Business systems, Functional E-Business systems, Electronic Commerce systems, Electronics commerce fundamentals, commerce applications and Issues.

BUSINESS DECISION: E –Business Decision Supports Systems for decision support, executive support systems, group decision support system, Artificial Intelligence Technologies in Business

DEVELOPMENT PROCESSES: Developing E-Business strategies, E-Business planning fundamentals, implementing E-Business strategies, Developing E-Business solutions – Developing E-Business systems, Implementing E-Business systems.

16 Hours

UNIT – III

MANAGEMENT CHALLENGES: Security and Ethical challenges of E-Business – Security, Ethical and Societal challenges of E-Business, security management of E –Business, Enterprise and Global management of E-Business Technology – Managing E-Business Technologies, Global E-Business, Technology Management.

5 Hours

MANAGING GLOBAL SYSTEMS: Growth of International Information Systems, Organizing International Information Systems, Managing Global systems, Off/Outsourcing, Global Value chain, Case Studies.

4 Hours

Course Outcomes (CO):

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

CO 1	Explain the basics of business information systems.
CO 2	Discuss the various available information technologies and hardware & software applications.
CO 3	Apply data resource management and explain various business applications.
CO 4	Discuss the concept of e-business.
CO 5	Discuss the various management challenges and management of global systems.

TEXTBOOKS :

1. Management Information Systems, managing information Technology in the Internet Worked Enterprise, Jams, A O'Braien - McGraw Hill publishing company Ltd., 2002. 5th edition ISBN 0-07048637-9
2. Managing information systems, W.S. Jawadekar, Tata McGraw Hill publishing Co. Ltd., New Delhi 2098. ISBN 0-07-463207-9

REFERENCE BOOKS :

1. Management Information Systems, Laudon & Laudon, PHI 2098 Ed. ISBN 81-203-1282-1
2. Management Information systems, S. Sadagopan, Prentice Hall of India, 2098 Ed. ISBN 81-203-1180-9
3. Information systems for Modern Management G.R.Murdick, PHI 2002.

Course Articulation Matrix:

Course Code / Name : 20MEE83 / Management Information System															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE83.1	3	3	1	2	1	1					3	2			1
C-20MEE83.2	2	3	1	3	1	1					2	2			1
C-20MEE83.3	3	2	1	2	1	1					3	2			1
C-20MEE83.4	2	3	1	1		1					3	1			1
C-20MEE83.5	3	3	1	2	2	2					2	2			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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OPERATIONS RESEARCH

Course Code	**20MEE84**	**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. 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. Develop a simulation model using Monte Carlo technique and solve the problem
4. Find operating characteristics of a queue using MM1 and MMC models. 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 – I

Chapter 1: Introduction

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

2 Hours

Chapter 2: Linear Programming I – Formulation and Graphic Solution –

Introduction, mathematical formulation of Linear Programming Problems (LPP), Graphical Solution

04Hours

Chapter 3: Linear Programming II – Simplex Method –

Introduction, Simplex method – slack, surplus and artificial variables

5 Hours

Chapter 4: Transportation Problem -

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

5 Hours

Chapter 5: Assignment Problem –

Formulation, Balance, unbalanced assignment problem, Maximization problem.

3 Hours

UNIT - II

Chapter 6: 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 **4 Hours**

Chapter 7: Replacement Theory –

Introduction, replacement policy for equipment which deteriorates gradually **4 Hours**

Chapter 8: Simulation –

Introduction, process of simulation, Monte Carlo Simulation, Problems on simulation **3 Hours**

Chapter 9 : 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) **4 Hours**

UNIT – III

Chapter 10: 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**

Course Outcomes (CO):

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. Develop a simulation model using Monte Carlo technique and solve the problem
CO 4	Find operating characteristics of a queue using MM1 and MMC models. 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.

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. Operations Research an Introduction, Taha H. A. 8th edition – Pearson Education 2007
2. Operations Research, S. D. Sharma -Kedarnath Ramnath & Co 2002.
3. Pradeep Prabhakar Pai, Operations Research, Oxford Higher Education, Oxfor University Press, New Delhi, 2013.
4. "Operation Research" AM Natarajan, P. Balasubramani, A Tamilaravari Pearson education 2009
5. Introduction to operation research, Hiller and Liberman, Mc Graw Hill. 5th edition 2001.
6. Operations Research: Principles and practice: Ravindran, Phillips & Solberg, John Wiley & Sons, India 2nd edition 2007
7. Operations Research, Prem Kumar Gupta, D S. Hira, S Chand Publications, New Delhi, 2nd edition 2008
8. —PERT & CPMǁ, L. S. Srinath, New Delhi 3rd edition 2001
9. Problems in Operations Research (Principles and Solutions), Prem Kumar Gupta, D S Hira- S.Chand & Company LTD, New Delhi 4th edition 2009
10. VTU e-learning EDUSAT Operations Research Course material for B.E and MBA.

MOOC/NPTEL Resources:

1. http://nptel.ac.in/courses/112106134/1

Course Articulation Matrix:

Course Code / Name : 20MEE84 / Operations Research															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE84.1	1	3	1						1	1					2
C-20MEE84.2	1	3	1						1	1	2				2
C-20MEE84.3	1	3	1						1	1	2				3
C-20MEE84.4	1	2	1						1	1	2				3
C-20MEE84.5	1	3	1						1	1	3				2

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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INTRODUCTION TO FINANCIAL MANAGEMENT

Course Code	**20MEE85**	**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 provide the 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 equip students 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 provide the students with the knowledge of and Merger Acquisition/ Restructuring and Securities and Portfolio Analysis
5. To orient students regarding financial management practices in Indian companies and Global enterprises.

UNIT – I

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 asset pricing model (Brief overview). **8 Hours**

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, Modigliani and Miller Model, Capital Structure decisions – EBIT, EPS analysis, ROI, REI analysis and Cash Flow comparative Analysis.

8 Hours

UNIT – II

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, Valuation of securities, features of convertible securities and warrants, SEBI guide lines on capital issues, stock market in India, Venture capital, Initial Public Offering.

8 Hours

Merger Acquisition and Restructuring: Reasons, Mechanics, Cost and benefits of a merger, Evaluation, terms and purchase of a division, Takeovers, Acquisitions, Portfolio and financial restructuring

Securities and Portfolio Analysis: Derivatives, Futures Trading.

9 Hours

UNIT – III

Financial Management in Sick Units: 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. **6 Hours**

Course Outcomes (CO):

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

CO 1	Outline 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	Outline the various concepts of capital budgeting. Apply the concept of risk and return to explore capital budgeting as investment options. Apply ROI-ROE and EBIT equivalence method to choose the optimal capital structure. Find cost of debt, cost of equity, cost of preference shares, cost of term loans from the given information.
CO 3	Identify the components of working capital. Compute the operating cycle. Describe the sources of long term finance and methods of generating them.
CO 4	Outline the reasons and mechanics (legal, tax and accounting aspects) of a merger. Compute costs and benefits of mergers.
CO 5	Identify the causes and symptoms of sickness of business units. Explain the steps involved in revival of sick units. 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.

TEXTBOOKS:

1. Financial Management Theory and practice – Prasanna Chandra – TMH – ISBN– 007-044501-X, 5th edn., 2005
2. Financial management – IM Pandey – Vikas Pub. House – ISBN 0- 7069-5435-1, 2005

REFERENCE BOOKS:

1. Financial Management Text & Problems – Khan & Jain – TMH – ISBN 0—07-460208-X.
2. Financial accounting – B.S. Raman – United publication – VoI II

Course Articulation Matrix:

Course Code / Name: 20MEE85/ Introduction to Financial Management															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE85.1	1	2								1	3		1		
C-20MEE85.2	1	2	2							1	3		1		
C-20MEE85.3	2	3	2							1	3		1		
C-20MEE85.4	1	2								1	3		1		
C-20MEE85.5	3	1								1	3		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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INNOVATION AND ENTREPRENEURSHIP

Course Code	**20MEE86**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Prerequisites:

The student must have learnt basics of Engineering concepts, applications and business as a whole.

Course Learning Objectives:

This Course will enable students to,

1 Understand Technological Innovation

2 Understand Innovation management and the difference between Invention and Innovation.

3 Appreciate the importance of Innovation as management process and Innovation management techniques.

4 Define Innovation system and Understand the importance of Technology management and Transfer.

5 Identify Technological Entrepreneurship and its types and Understand the Institutional support provided for Entrepreneurs

UNIT – I

INTRODUCTION TO TECHNOLOGICAL INNOVATION **14 Hours**

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

INTRODUCTION TO INNOVATION MANAGEMENT

Innovation Management Through Management of Knowledge and Education – Types of Learning - Difference Between Innovation and Invention - Types and Characteristics of Innovation.

INNOVATION AND COMPETITIVENESS

Case Study – Barriers for Innovation and Competitiveness.

UNIT – II

INNOVATION AS A MANAGEMENT PROCESS **14 Hours**

Activities to enhance companies capacity for innovation – Management of Technological Innovation: Corporate Perspective, National Perspective, Theoretical Perspective and

Individual Perspective - Challenges in Technological Innovation Management - Case Study in Technological Innovation Management - Innovation Management Techniques (IMTs).

INNOVATION SYSTEMS

The Concept of Innovation Systems - Innovation Systems: Sectoral, Regional, National.

TECHNOLOGY MANAGEMENT AND TRANSFER

Technology Transfer - Impacts of MNCs in technology transfer -

UNIT – III

INTRODUCTION TO TECHNOLOGICAL ENTREPRENEURSHIP 11 Hours

Types of Entrepreneurship: Mixed Entrepreneurship, Pure Entrepreneurship, Social Entrepreneurship, Collaborative Entrepreneurship, Internal Entrepreneurship, External Entrepreneurship - Sustainable Entrepreneurship -

INSTITUTIONAL SUPPORT

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

Course Outcomes (CO):

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

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

TEXTBOOK:

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

REFERENCE BOOK:

1 Dick Whittington, ―Digital Innovation and Entrepreneurship‖, Cambridge University Press,2018.

Course Articulation Matrix

Course Code / Name : 20MEE86/ INNOVATION AND ENTREPRENEURSHIP															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE86.1	3	2				1	1		1			1			2
C-20MEE86.2	3	2				1	1		1			1			2
C-20ME8863	2	2				1	1		1			1			2
C-20MEE86.4	2	2				1	1		1			1			1
C-20MEE86.5	3	2				1	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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INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Course Code	**20MEE91**	**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 basics of artificial intelligence.
2. Know about search algorithms
3. Understand statistical and probabilistic reasoning.
4. Understand Markov Decision Process.
5. Understand the role of learning in the working of decision making systems.

UNIT – I

ARTIFICIAL INTELLIGENCE: Introduction, definition, underlying assumption, importance of AI, AI and related fields. History, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search

graph and Search tree

SEARCH ALGORITHMS: Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search.

14 Hours

UNIT - II

KNOWLEGDE AND REASONING: Agents that reason logically, logical reasoning systems, Probability, conditional probability, Bayes Rule, Bayesian Networks-representation, construction and inference, temporal model, hidden Markov model.

MARKOV DECISION PROCESS: MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs. **14 Hours**

UNIT - III

LEARNING: Learning in Neural and Belief Networks, Reinforcement learning,

Philosophical foundations and AI present and future

11 Hours

Course Outcomes (CO):

At the end of the course the student will be able to	
CO 1	Explain about artificial intelligence
CO 2	Describe the application of search algorithms
CO 3	Describe the use of knowledge representation and reasoning in developing artificial systems
CO 4	Explain Markov decision process
CO 5	Describe the use of neural networks for generating knowledge required by decision making systems, the philosophical foundations of AI and its present and future

TEXTBOOKS:

1. Stuart J Russel & Peter Norvig, —Artificial Intelligence – A Modern Approachǁ, Prentice Hall, Englewood Cliifs, New Jersey, 2095, ISBN 0-13-103805-2
2. Artificial Intelligence, Elaine Rich & Kevin Knight, M/H 2083.

REFERENCE BOOKS:

1. Principles of Artificial Intelligence, Springer Verlag, Berlin, 2081.
2. Artificial Intelligence in business, Science & Industry, Wendy B. Ranch
3. A guide to expert systems, Waterman, D.A., Addison – Wesley inc. 2086
4. Building expert systems, Hayes, Roth, Waterman, D.A. Addison – Wesley, 2083

MOOC/NPTEL Resources:

1. https://nptel.ac.in/courses/106105077
2. https://nptel.ac.in/courses/106106126
3. https://aima.cs.berkeley.edu

Course Articulation Matrix:

Course Code / Name: 20MEE91/ Artificial intelligence															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE91.1	3	2				1	1					1			
C-20MEE91.2	2	3				1	1					1			
C-20MEE91.3	2	3				1	1					1			
C-20MEE91.4	2	3				1	1					1			
C-20MEE91.5	2	3				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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INTRODUCTION TO MATLAB PROGRAMMING

Course Code	**20MEE92**	**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 Explain the main features of the MATLAB program development environment to enable their usage in the simple engineering problems.
2 Implement simple mathematical functions/equations in numerical computing environment such as MATLAB
3 Able to program scripts and functions using the MATLAB development environment.
4 Create and control simple plot and user-interface graphics objects in MATLAB
5 Apply numeric techniques and computer simulations to solve engineering-related problems.

UNIT - I

MATLAB Basics: **13 Hours**

The MATLAB environment - Basic computer programming - Variables and constants, operators and simple calculations - Formulas and functions - MATLAB toolboxes.

Matrices and vectors:

Matrix and linear algebra review - Vectors and matrices in MATLAB - Matrix operations and functions in MATLAB

UNIT – II

Computer programming Algorithms and structures **14 Hours**

MATLAB scripts and functions (m-files) - Simple sequential algorithms - Control structures

MATLAB programming and Numerical Simulations

MATLAB Programming: Reading and writing data, file handling - Personalized functions - Toolbox structure – MATLAB graphic functions

UNIT - III

12 Hours

Numerical simulations: Numerical methods and simulations - Random number generation

Introduction to Simulink

Definition, Basic Elements, Blocks and Lines, Basic Blocks – Sources, Sinks, Logical Operation Blocks, Mathematical Operation Blocks, Ports and Subsystems, Launching of Simulink, Library Browser and options available. Modelling of Simple Mathematical Problems with questions - Addition, Subtraction, Division and Multiplication using Simulink, Complex Number Problems – Addition, Subtraction, Division and Multiplication. Defining a Matrix in Simulink – Mathematical operations of Matrices. Signal and Parameters in a Signal – Amplitude, Phase, Offset, Frequency, Theoretical and Simulation of the same using Simulink. Different Types of Signal – Sine, Square, Step and Ramp. Trigonometry Functions and its Calculations using Simulink. Calculus – Differentiation and Integration (Continuous Blocks) of a Signal, Transport Delay Block. Discontinuous Blocks – Saturation and Relay. Logical and Bit Operations – AND Gate, OR Gate, NAND Gate, NOR Gate, XOR Gate, XNOR Gate – Theoretical Truth Table calculations with Logical Diagram and Executing the same calculation using Simulink. Logical and Bit Operations using Dashboard.

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

TEXTBOOKS:

1. Duane C. Hanselman, Bruce L. Littlefield, Mastering Matlab. Pearson, 1 edition (28 September 2011)
2. Essentials of MATLAB Programming , second edition, by Stephen J. Chapman, published by CENGAGE Learning, 2009

REFERENCE BOOKS:

1. Raj Kumar Bansal, Ashok kumar Goel, MATLAB and its Applications in Engineering, 2e Paperback – 1 March 2016
2. Rudra Pratap, Getting Started with MATLAB A Quick Introduction for Scientists and Engineers, Seventh Edition

MOOC/NPTEL Resources:

1. Matlab Programming for Numerical Computation, NPTEL

Course Articulation Matrix:

Course Code / Name: 20MEE92 / Introduction to MATLAB Programming															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	P02	P03	P04	P05	P06	P07	P08	P09	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE92.1	1				3				1	1		1			
C-20MEE922	2				3				1	1		1			
C-20MEE92.3	1				3				1	1		1			
C-20MEE92.4	1				3				1	1		1			
C-20MEE92.5	3	2			3				1	1		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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INTRODUCTION TO BUSINESS ANALYTICS WITH PYTHON

Course Code	**20MEE93**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:0:2**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to,

1 Understand the concepts of predictive analytics and solve problems related to hypothesis testing, control charts, regression and correlation and time series analysis.
2 Write programs using the fundamental concepts and modules of Python.
3 Solve linear programming problems using graphical and simplex approaches and prescribe solutions.
4 Apply relevant python modules to programs for problems related to predictive and prescriptive analytics.
5 Solve transportation LPP. Apply the relevant python module to solve transportation LPP.

UNIT – I

Introduction to Business Analytics **16 Hours**

Types of data, representation of data using Measures of central tendency and dispersion, Central Limit theorem.

Predictive Analytics

Hypothesis Testing & Business Analytics

Hypothesis Testing: Null and Alternative Hypotheses; Z Test, t test and F test.

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}. – Process capability ratio, Concept of Six sigma

Time Series Analysis

Components of time series, Trend analysis: Least Square method of Forecasting, Numerical Problems

Introduction to Python (To be covered mainly in active learning sessions)

Data types, Keywords, Comments, Loops/ Iteration, arrays, Conditional Statements, Variables, Expressions, and Statements, Lists, Tuples

Reading and writing files, Classes, Types of errors.

Python Modules & Packages for Data Science/ Analytics: Pandas, Matplotlib, NumPy, Dataframe, Pulp toolboxes of Python to help solve Predictive and Prescriptive analytics problems

UNIT – II

Prescriptive Analytics **8 Hours**

Linear programming problems: Characteristics of LPP. Simple problems on mathematical formulation of LPP, Graphical solution to LPP. The simplex method (Minimization and Maximization).

Active Learning sessions on Python application in Business Analytics 07 Hours (AL)

Application of Python modules to solve at least one problem of Data retrieval from spreadsheets, Z test, t test and F tests, Time Series analysis, Correlation, and regression, plotting control charts and finding process capability, LPP (Maximization and Minimization) using python,

UNIT – III

Transportation LPP models **04+04(AL)**
8 Hours

Structure of transportation LPP, Maximization and Minimization problems, Solving Transportation problems using Python programming and toolboxes.

Course Outcomes (CO):	
At the end of the course the student will be able to,	
CO 1	Apply the concepts of predictive analytics and solve problems related to hypothesis testing, control charts, regression and correlation and time series analysis.
CO 2	Write programs using the fundamental concepts and modules of Python.
CO 3	Solve linear programming problems using graphical and simplex approaches and prescribe solutions.
CO 4	Apply relevant python modules to programs for problems related to predictive and prescriptive analytics.
CO 5	Solve transportation LPP. Apply the relevant python module to solve transportation LPP.

TEXTBOOKS:

1. Quantitative Total Quality Management**:** Techniques in Management, N.D. Vohra, Tata McGraw Hill, 2015.
2. Production and Operations Management, William J Stevenson, Tata McGraw Hill, 8thEdition. 2011
3. Total Quality Management**,** Dale H. Besterfield et al., Pearson Education, 3rd edition, 2011.
4. Introduction to Data Science, - A Python Approach to Concepts, Techniques and Applications, Laura Igual, Santi Segu, Springer, 2017
5. Think Python, How to Think Like a Computer Scientist, Allen Downey, Green Tea Press, 2012 (ebook)

REFERENCE BOOKS:

1. Statistical Quality Control, **E.L. Grant and R.S. Leavenworth, 7th edition, McGraw- Hill publisher, 2004.**
2. Production / Operations Management, Joseph G Monks, McGraw Hill Books, 2001
3. Production / Operations Management, R. Pannerselvam, PHI India, 2011
4. Operations Research, Prem Kumar Gupta, D S. Hira, S Chand Publications, New Delhi, 2nd edition 2008

Other Sources

1. NPTEL course material related to business analytics.
2. python.org
3. stackoverflow.com
4. openbookproject.net/thinkcs/python/english2e
5. automatetheboringstuff.com

Course Articulation Matrix:

Course Code / Name: 20MEE93 / INTRODUCTION TO BUSINESS ANALYTICS WITH PYTHON															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	P02	P03	P04	P05	P06	P07	P08	P09	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE93.1	3	2									3	1			3
C-20MEE93.2	3	2			3				3			1			3
C-20MEE93.3	3	2									3	1			3
C-20MEE93.4	3	2			3				3			1			3
C-20MEE93.5	3	2			2				3		3	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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INTRODUCTION TO PYTHON PROGRAMMING			
Course Code	**20MEE94**	**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 Construct Python programs using data types and looping .
2 Understand the concepts of Strings and manipulating strings.
3 Make use of python operators for manipulating lists, dictionaries and files.
4 Design object-oriented Python programs using classes and objects.
5 Perform numerical Computation using python

UNIT – I

Introduction: Introduction to python, Installing Python; basic syntax, interactive shell, editing, saving, and running a script. The concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages. Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation.
Strings: Strings and text files; manipulating files and directories, OS and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated).
String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa, Binary, octal, hexadecimal numbers
Lists, tuples, and dictionaries: Basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries.

15 Hours

UNIT – II

Functions: Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions

Classes and OOP: Classes, objects, attributes and methods; defining classes; design with classes, data modelling; persistent storage of objects, inheritance, polymorphism, operator overloading (_eq_, _str_, etc); abstract classes; exception handling, try block.

Graphical user interfaces: event-driven programming paradigm; creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames Simple CGI form

15 Hours

UNIT – III

Numerical Computation using python

Systems of Linear Algebraic Equations, Interpolation and Curve Fitting, Roots of Equations, Numerical Differentiation. **9 Hours**

Course Outcomes (CO):	
At the end of the course the student will be able to,	
CO 1	Explain the basic program constructs of Python Programming.
CO 2	Make use of python operators for manipulating lists, dictionaries and files.
CO 3	Write and use functions in python for simple problems.
CO 4	Design object-oriented Python programs using classes and objects.
CO 5	Solve linear Algebraic and differential equations using python for simple problems
TEXTBOOK:	
1	Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978-1111822705.
E BOOK:	
1	http://www.diveintopython3.net/
MOOC/NPTEL Resources:	
1	https://nptel.ac.in/courses/115/104/115104095/

Course Articulation Matrix:

Course Code / Name: 20MEE94 / INTRODUCTION TO PYTHON PROGRAMMING															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	P02	P03	P04	P05	P06	P07	P08	P09	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE94.1	1				3							1			
C-20MEE94.2	1				3							1			
C-20MEE94.3	1				3							1			
C-20MEE94.4	1				3							1	1	1	1
C-20MEE94.5	1				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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MICROELECTROMECHANICAL SYSTEMS

Course Code	**20MEE96**	**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 basics of MEMS and market for MEMS.
2. Know the various materials for micromachining and additives used.
3. Understand various techniques of micromachining.
4. Understand some basic concepts of micromechanics.
5. Know the basics of thermal and fluidic MEMS.

UNIT – I

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.

8 Hours

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 ($XeFR_2R$), Dry etching, SFR_6R, DRIE, Bosch process, Cryogenic dry etching, Sidewall roughness, Etch lag, Combined isotropic and anisotropic dry etching, SCREAM, ASIP.

8 Hours

UNIT – II

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 Process, Wafer bonding, Anodic bonding, Fusion bonding, SOI wafers. **8 Hours**

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.

8 Hours

UNIT – III

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.

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.

7 Hours

Course Outcomes (CO):

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

CO 1	Explain the basics of MEMS.
CO 2	Compare different micromachining techniques and additives used.
CO 3	Explain various techniques of micromachining.
CO 4	Apply basic concepts of micromechanics in developing MEMS systems.
CO 5	Explain different types of MEMS system.

TEXTBOOKS:

1. Micromachined Transducers Sourcebook, Greg Kovacs, McGraw-Hill publications, New York, 2098
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, 2PndP Edition, Taylor & Francis Publications, 20.

Course Articulation Matrix:

Course Code / Name: 20MEE96/ Micro-Electro-Mechanical Systems															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE96.1	3	3	3	2				2	1	1	1	1	3		
C-20MEE96.2	2	3	3	3				3	1	1	1	1	3		
C-20MEE96.3	3	3	2	3				1	1	1	1	1	3		
C-20MEE96.4	3	3	2	2				1	1	1	1	1	3		
C-20MEE96.5	2	2	2	3				2	1	1	1	1	2		

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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INTRODUCTION TO MACHINE LEARNING*

Course Code	**20MEE97**	**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 fundamentals of machine learning, its relationship with artificial intelligence, linear models for classification, dimensionality reduction and other design issues related to machine learning algorithms.
2. Appreciate the use of neural networks.
3. Know about support vector machines and its application and an overview about deep learning.
4. Provide an overview about deep learning.
5. Know the application of different machine learning techniques in real life applications.

UNIT – I

Chapter 1: Introduction to machine learning- need, applications, advantages and limitations. What is Artificial Intelligence? Difference between AI and ML, case study examples. **4 Hours**

Chapter 2: Linear models for classification - Decision trees, Regression, Probability theory / distributions. **4 Hours**

Chapter 3: Introduction to Neural networks - learning theory, classification, advantages, limitations, applications, feed forward networks, network training, Bias / variance tradeoff, generalization errors, model selection, VC dimensions. **5 Hours**

UNIT – II

Chapter 4: Multilayer perceptron- Characteristics, error back propagation algorithm, XOR Problem, Sequential and batch modes of learning, Generalization, Case study on Multilayer perceptron. **5 Hours**

Chapter 5: 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 **9 Hours**

UNIT – III

Chapter 6: 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. **9 Hours**

Chapter 7: Other topics- Introduction to relevant vector machines (RVM), difference between RVM and SVM, Introduction to Deep Learning Introduction to Convolutional neural network. **3 Hours**

Note: * PBL Course

Course Outcomes (CO):	
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.
CO 2	Discuss about neural networks, learning theory, feed forward networks and identify issues related to machine learning algorithms.
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 and present some case studies on neural network models and support vector machines.

TEXTBOOKS:

1. Neural Networks – A comprehensive Foundation, Simon Haykin, Pearson Prentice Hall, Second Edition, 2005, ISBN 81 – 7808 -300 - 0
2. Understanding Machine Learning – from Theory to Algorithms by Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 2014, ISBN978-1-107-05713-5 Hardback
3. Pattern Recognition and Machine Learning by Christopher Bishop, Springer, 2006, ISBN:978-0-387-31073-2
4. Goodfellow, I., Bengio, Y., Courville, A., Deep Learning, Part II, MIT Press, 2016.

REFERENCE BOOKS:

1. Vapnik, V., An Overview of Statistical Learning Theory, IEEE Transactions on Neural Networks, Vol. 10, pp. 988-999, 2099.
2. Christopher Burges, A Tutorial on Support Vector Machines for Pattern Recognition, Data Mining and Knowledge Discovery, 2098.
3. Kurt Hornik, Maxwell Stinchcombe and Halbert White, Multilayer Feedforward Networks are Universal Approximators, Neural Networks, 2089.
4. Any other web based source
5. Any text book on machine learning, neural networks, SVMs etc.

MOOC/NPTEL

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

Course Articulation Matrix:

Course Code / Name : 20MEE97/ Introduction to Machine Learning															
Course Outcomes (CO)	Program Outcomes (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20MEE97.1	3	2	1	0	0	2	0	0	0	0	0	2			
C-20MEE97.2	3	2	1	0	0	2	0	0	0	0	0	2			
C-20MEE97.3	3	2	1	0	0	1	0	0	0	0	0	2			
C-20MEE97.4	3	2	1	0	0	1	0	0	0	0	0	2			
C-20MEE97.5	3	2	1	0	0	1	0	0	0	0	0	2	2	2	2

1: Low 2: Medium 3: High

CIE Scheme

Assessment	Weightage in marks
MSE -I	15 marks
MSE -II	15 marks
PBL	20 marks
TOTAL	50 marks

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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OPEN ELECTIVE - I (VII Semester) - 2023-2024

Sl. No.	Code	Name
1.	20MA8X02	Linear Algebra (for all except CS, IS, EC, CCE & AIML)
2.	20HU8X03	Intellectual property rights (for all)
3.	20CV8X07	Environment Impact Assessment (for all except Civil)
4.	20ME8X08	Industrial Pollution Control (for all except Mechanical)
5.	20HU8X24	Professional and Cognitive Communique (for all)
6.	20ME8X28	Operations Management and Entrepreneurship (for all except Mechanical)
7.	20IS8X38	Introduction to Python Programming (for all except CS & IS)
8.	20BT8X40	Bio Fuel Engineering (for all except BT)
9.	20BT8X42	Solid Waste Management (for all except BT & Civil)
10.	20EC8X59	PCB Design (For all except E&C)
11.	20ME8X63	Innovation & Entrepreneurship (for all)
12.	20HU8X68	Introduction to Yoga (The classes will be conducted from 7.00 a.m. to 8.00 a.m. Those who are willing to come at 7.00 a.m. should only register)
13.	20HU8X70	Overview of Indian Culture and Arts (for all)
14.	20HU8X71	Principles to Physical Education (The classes will be conducted from 5.30 p.m. to 6.30 p.m. Those who are willing to come at 5.30 p.m. should only register)
15.	20HU8X72	Introduction to Japanese language (Students with no backlogs, CGPA should be above 7.0 & who opt to get placed in Japanese companies in Japan/India are eligible to register)
16.	20HU8X74	Introduction to German Language (for all)
17.	20ME8X75	Sustainable Development Goals (for all)
18.	20IS8X76	Web Technologies (for all except CS & IS)
19.	20CS8X77	Programming in Java (for all except EC,CS & IS)
20.	20CS8X78	Data Structures & Algorithms (for all except EC,CS & IS)
21.	20EE8X79	Electric Vehicle Technology (for all except EE)
22.	20HU8X81	National Cadet Corps: Organization, Functions & Capabilities (for only NCC Cadet Students)
23.	20EC8X82	Fundamentals of Image Processing – a practical approach (Only for CV, ME & BT)
24.	20HU8X86	Introduction to Yakshagana (for all - who are familiar with kannada Language)
25.	20ME8X88	Marketing Management (for all except Mechanical)

OPEN ELECTIVE - II (VIII Semester)

Sl. No	Code	Name
1.	20MA8X01	Graph Theory (for all except CS & IS)
2.	20HU8X03	Intellectual property rights *(for all except for those who have taken the subject in the VII semester)*
3.	20BT8X05	Nanotechnology (for all except BT)
4.	20CV8X07	Environment Impact Assessment *(for all except Civil & except for those who have taken the subject in the VII semester)*
5.	20ME8X08	Industrial Pollution Control *(for all except Mechanical & except for those who have taken the subject in the VII semester)*
6.	20EE8X10	Non-Conventional Energy Systems *(for all except EE, Mech. & except for those who have taken the subject in the VII semester)*
7.	20CS8X15	Essentials of Information Technology (for all except CS & IS)
8.	20EC8X18	Consumer Electronics (for all except EC)
9.	20ME8X28	Operations Management and Entrepreneurship *(for all except Mechanical & except for those who have taken the subject in the VII semester)*
10.	20ME8X33	Human Resource Management (for all except Mechanical)
11.	20HU8X37	Linguistics and Language Technology (for all)
12.	20MA8X43	Number Theory (for all)
13.	20ME8X65	Automotive Engineering (For all except Mechanical)
14.	20CV8X67	Disaster Management (For all except Civil)
15.	20HU8X68	Introduction to Yoga *(for all except for those who have taken the subject in the VII semester)*
16.	20HU8X71	Principles to Physical Education *(for all except for those who have taken the subject in the VII semester)*
17.	20HU8X72	Introduction to Japanese language *(for all except for those who have taken the subject in the VII semester)*
18.	20HU8X74	Introduction to German Language (for all *except for those who have taken the subject in the VII semester)*
19.	20ME8X75	Sustainable Development Goals (for all *except for those who have taken the subject in the VII semester)*
20.	20CS8X80	Internet of Things (for all except EC,CS & IS)
21.	20IS8X83	Software Engineering Practices (for all except CS & IS)
22.	20IS8X84	Introduction to Cyber Security (for all except CS & IS)
23.	20EC8X85	Space Technology & Applications (for all except E&C)
24.	20HU8X86	Introduction to Yakshagana (for all - who are familiar with kannada language)

GRAPH THEORY			
Course Code	**20MA8X01**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

1. Explain subgraphs, bipartite graphs, isomorphic graphs etc. Apply the concept of trees and its properties
2. Distinguish between Hamilton and Eulerian graph. Distinguish between planar and nonplanar graphs and apply their properties to solve problems.
3. Represent a graph in terms of adjacency matrix, incidence matrix etc. and vice-versa.
4. Find the shortest path between two vertices in a graph. Find minimal spanning tree.

UNIT – I

Introduction to graphs **11 Hours**

Graphs and Graph Models, digraphs, Konigsberg bridge problem. Special Types of Graphs: Subgraphs-spanning and induced subgraphs, Isomorphism of graphs. Some Special Simple Graphs, complete graph, Bipartite Graphs.
Connectivity: point and line connectivity
Trees and its properties.

Eulerand Hamilton graphs **4 Hours**

Eulerian and Hamiltonian graphs and their applications.

UNIT – II

Planar graphs: Euler's polyhedron formula, outer planar graphs, applications **9 Hours**

Colorability: Chromatic number, five color theorem, chromatic polynomial, Applications of graph coloring.

Representation of graphs: **6 Hours**

adjacency matrix, incidence matrix, circuit matrix, cut set matrix. Path matrix

UNIT – III

Network Flows: Max -flow and Min-cut Theorem(statement), problems. **04 Hours**

Shortest paths in weighted graphs:
Dijkstra's algorithm to find shortest paths.

Spanning trees: **05 Hours**

Algorithms to find a spanning tree, minimal spanning tree-Kruskal's & Prim's algorithm.

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

1.	Distinguish between bipartite and complete bipartite graphs, identify whether two graphs are isomorphic, find subgraphs of a graph etc.
2.	Distinguish between Eulerian and Hamiltonian graphs.
3.	Identify whether a graph is planar and to find the chromatic polynomial of a graph.
4.	Representing graphs in Matrices.
5.	Apply algorithmic methods to find the shortest path between two given vertices. Use a suitable algorithm to find a minimal spanning tree.

Course Outcomes Mapping with Program Outcomes & PSO

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

1: Low 2: Medium 3: High

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:

1.	Methods recommended: Two Tests (80%), Written Quiz (10%) and module assignments (10%).
2.	The class teacher must decide the topic for closed book test and Written Quiz. In the beginning only teacher must announce the methods of CIE for the subject.

Semester End Examination:

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

TEXTBOOKS:

1.	F. Harary, "Graph theory", Narosa Publishing House, 1988.
2.	Narsing Deo, "Graph Theory with applications to Engg. and Comp. Sciences", PHI,1974.
3.	"DiscreteMathematicsanditsapplications",KennethH.Rosen,TataMcGrawHill,VEdition-2003.

REFERENCE BOOKS:

1.	D.B.West, "Introduction to Graph Theory", PHI,2001.
2.	Chartrand and Zhang, "First Course in Graph Theory", 2012

E Books / MOOCs/ NPTEL

1.	http://diestel-***graph-theory***.com.
2.	https://nptel.ac.in/courses/111106102

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LINEAR ALGEBRA

Course Code	**20MA8X02**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

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

UNIT - I

Vector spaces

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

Linear Transformations

15 Hours

UNIT - II

Canonical Forms

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

Inner Product Spaces

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

15 Hours

UNIT - III

Symmetric Matrices and Quadratic Forms:

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

09 Hours

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

1.	Interpret vectors in two and three-dimensional spaces both algebraically and geometrically.
2.	Analyze the concept of a linear transformation as a mapping from one vector space to another and be able to calculate its matrix representation with respect to standard and nonstandard bases.
3.	Understand the concepts of Jordan and rational canonical forms.
4.	Make use of Gram-Schmidt process to produce an orthonormal basis and also able to use least square approximation method to obtain the solution of ill conditioned system.
5.	**Apply techniques of constrained optimization singular value decomposition and PCA for problems arising in various engineering fields.**

Course Outcomes Mapping with Program Outcomes & PSO

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

1: Low 2: Medium 3: High

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

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:	
1.	Methods recommended: Two Tests (80%), Written Quiz (10%) and module assignments (10%).
2.	The class teacher must decide the topic for closed book test and Written Quiz. In the beginning only teacher must announce the methods of CIE for the subject.

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

TEXTBOOKS:	
1.	**Kenneth Hoffman and Ray Kunze, "Linear Algebra," 2nd edition, Pearson Education (Asia) Pte. Ltd, 2004.**
2.	David C.Lay, "Linear Algebra and its Applications",3rd edition, Pearson Education (Asia) Pte. Ltd, 2005.
REFERENCE BOOKS:	
1.	M. Artin , Algebra Prentice Hall of India.2004.
2.	Gilbert Strang, "Linear Algebra and its Applications", 4th edition, Thomson Learning Asia, 2003.
3.	Bernard Kolman and David R. Hill, "Introductory Linear Algebra with Applications", Pearson Education (Asia) Pte.Ltd 7th edition ,2003.
4.	Sheldon Axler, "Linear Algebra Done Right", Springer International Publication, Third Edition,2015.

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INTELLECTUAL PROPERTY RIGHTS

Course Code	20HU8X03	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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NANOTECHNOLOGY			
Course Code	**20BT8X05**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

***Prerequisites*:** Chemistry, Physics
***Corequisites*:** Nil

Course Learning Objectives:
The objective of this course is
- To learn fundamental concepts of nanoscience and nanotechnology
- To appreciate the application of nanoscience to various fields of engineering.

UNIT - I

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

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

15 Hours

UNIT – II

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

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

15 Hours

UNIT - III

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

9 Hours

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

Mapping of POs & COs:

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

TEXTBOOKS:

1. Lindsay, S.M. *Introduction to Nanoscience*, Oxford University Press, 2009.
2. Robert Kelsall and Hamley, I. (Ed.). *Nanoscale Science and Technology*, Wiley, 2005.
3. Bharat Bhushan (Ed.), *Springer Handbook of Nanotechnology*, 3rd Ed., Springer, 2010.

REFERENCE BOOKS:

1. Booker, R. and Earl Boysen (Eds), *Nanotechnology*, Wiley Dreamtech, 2005.
2. Murthy, D.V.S. *Transducers and instrumentation*, Prentice Hall of India, 2010.
3. Schmidt, G. *Nanotechnology Assessment and perspectives*, Springer, 2006.
4. Ratner M. and Ratner, D. *Nanotechnology – A gentle Introduction to the Next Big Idea*, Pearson Education, 2005.
5. Silberzan, J.B.P. *Microfluidics for Biotechnology*, ARTECH house, 2010.
6. Cao, G. *Nanostructure and nanomaterial*, World scientific, 2011.

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ENVIRONMENTAL IMPACT ASSESSMENT			
Course Code	**20CV8X07**	**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	**20ME8X08**	**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 : 20ME8X08/ Industrial Pollution Control														
Course Outcomes (CO)	**Program Outcomes (PO)**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C-20ME8X08.1	2								1	1		1		
C-20ME8X08.2	2								1	1		1		
C-20ME8X08.3	2								1	1		1		
C-20ME8X08.4	2								1	1		1		
C-20ME8X08.5	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	**20EE8X10**	**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
20EE8X10.1	2	3				1	2	1				
20EE8X10.2	2	3				1	2	1				
20EE8X10.3	2	3				1	2	1				
20EE8X10.4	2	3				1	2	1				
20EE8X10.5	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	**20CS8X15**	**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	**20EC8X18**	**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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PROFESSIONAL & COGNITIVE COMMUNIQUÉ

Course Code	**20HU8X24**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Learning Objectives:

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

UNIT - I

Common sense and Emotional Intelligence Common sense, Commonsensical Consensus, Critical thinking, Unsettling commonsensical Consensus, Role of language in Common sense and Critical Thinking; Nature & Functions of Emotional Intelligence, Emotions, Intelligence and Creativity, Growth of Emotional Intelligence	15
Etiquettes & Workplace Etiquette, Workplace Etiquettes, Workplace Readiness Skills, Significance of Cross-Cultural Understanding; Cultural Sensitivity, Impact of social media in Workplace	

UNIT - II

Social Networking Sites and its Impacts Emergence of social media, Impact on Gender and Self Representation, Regulatory and Liberatory aspects of social media, Offline Norms & Online Behaviour	15
Gender and Body Gender & Sex, Genderization, Homogeneity and Heterosexuality, Gender Expressions, Gender Schooling, Representations of Body, Objectification, Gender Perspectives of Body, Different Ways of Seeing the Body, Discipline & Coercion, ISA & RSA	

UNIT - III

Writing Types of Writing, Note Taking Methods, Plagiarism **Reading** Styles of Reading, Types of Reading,Scanning, Skimming	9

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

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

Course Outcomes Mapping with Program Outcomes & PSO

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

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Geetha.V. Gender. Kolkatta: Web Impressions, 2009.
2.	Bailey, Jane, et al. "Negotiating with Gender Stereotypes On Social Networking Sites: From "Bicycle Face" to Facebook." Journal of Communication Enquiry 37.2 (2013): 91-112.
3.	Barry, Peter. Beginning Theory. New Delhi: Viva Books, 2010.
4.	Berger, John. Ways of Seeing. London: Penguin Books, 1977.
5.	Cranny-Francis, Anny, et al. Gender Studies: Terms and Debates. New York: Palgrave Macmillan, 2003.
6.	Gauntlett, David. Media, Gender and Identity: An Introduction. London: Routledge, 2008
7.	Pilcher, Jane, and Imelda Whelehan. 50 Key Concepts in Gender Studies. London: Sage, 2004. Print.
8.	Jeanne, Haraway Donna. Simians, Cyborgs, and Women. London: Free Association Books, 1991. Web.
9.	Koskela, Hille. "Webcams, TV Shows and Mobile Phones: Empowering Exhibitionism." Surveillance & Society 2.3 (2004): 199-215.Web.

E-RESOURCES:

1.	http://www.cyberpsychology.eu/view.php?cisloclanku=2009061501/ >.
2.	http://www.surveillance-and-society.org/articles2(2)/webcams.pdf
3.	http://eprints.rclis.org/19790/>.

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OPERATIONS MANAGEMENT & ENTREPRENEURSHIP

Course code	**20ME8X28**	**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: 18ME8X28/ Operations Management & Entrepreneurship															
Course Outcomes (CO)	**Program Outcomes (PO)**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-20ME8X28.1	3	1	0					1	1	1	1				
C-20ME8X28.2	1	2	0						1	1	3				
C-20ME8X28.3	2	2	0				1	0	1	1	3				
C-20ME8X28.4	3	1	0			1	0	1	1		2				
C-20ME8X28.5	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	**20ME8X33**	**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 : 20ME8X33 / 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-20ME8X33.1	3	-	-	-	-	1	-	-	1	1	-	1	-	-
C-20ME8X33.2	3	-	-	-	-	1	-	-	1	1	-	1	-	-
C-20ME8X33.3	3	-	-	-	-	1	-	-	1	1	-	1	-	-
C-20ME8X33.4	3	-	-	-	-	1	-	-	1	1	-	1	-	-
C-20ME8X33.5	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	**20HU8X37**	**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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INTRODUCTION TO PYTHON PROGRAMMING			
Course Code	**20IS8X38**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Prerequisites:
Student must have fundamental knowledge of procedure-oriented programming.

Course Learning Objectives (CLOs):
At the end of the course student should be able to:

- Construct Python programs using data types and looping.
- Design object-oriented Python programs using classes and objects.
- Design useful stand-alone and CGI applications in Python.

UNIT - I

INTRODUCTION: Introduction to python, Installing Python; basic syntax, interactive shell, editing, saving, and running a script. The concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages. Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation.
STRING MANIPULATIONS: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa, Binary, octal, hexadecimal numbers
LISTS, TUPLES, AND DICTIONARIES: Basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries.

15 Hours

UNIT – II

FUNCTIONS: Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions

CLASSES AND OOP: Classes, objects, attributes and methods; defining classes; design with classes, data modelling; persistent storage of objects, inheritance, polymorphism, operator overloading (_eq_, _str_, etc); abstract classes; exception handling, try block

15 Hours

UNIT – III

FILE HANDLING: Manipulating files and directories, Reading from Text Files, Writing to Text Files, Reading from Binary Files, Writing to Binary Files, Seeking Within Files, Creating and Reading a formatted file (csv or tab-separated).

GRAPHICAL USER INTERFACES: event-driven programming paradigm; creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames Simple CGI form

9 Hours

Course Outcomes:

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

Table: Mapping of COs to PIs, POs and BTL

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

Mapping Course Outcomes with Programme Outcomes:

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

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

TEXTBOOK:

1) Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978-1111822705

ADDITIONAL RESOURCES:

1. Think Python. PDF is free.

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** full questions from **Unit - I &Unit – II** and **1** full question from **Unit – III.**

BIOFUEL ENGINEERING			
Course Code	**20BT8X40**	**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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SOLID WASTE MANAGEMENT			
Course Code	**20BT8X42**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

***Prerequisites*:** Nil
***Co-requisites*:** Nil

Course Learning Objectives:

The objective of this course is

1. To learn types of solid wastes, collection, treatment and disposal methods.
2. To understand various processing techniques and regulations of treatment and disposal.

UNIT – I

INTRODUCTION TO SOLID WASTES AND ITS SEGREGATION & TRANSPORTATION

Solid waste – Definition, Sources of waste, Classification of Solid waste, Characteristics of Solid Waste (Physical, Chemical, Biological), Solid waste problems – impact on environment and health. Concept of waste reduction, recycling and reuse.

Waste collection and segregation: Solid waste generation, Onsite handling and segregation of wastes at source, Collection and storage of municipal solid wastes, Equipment used and manpower required in collection, Collection systems and routes.

Transportation: Transfer stations: types, location, maintenance, Methods and means of transportation.

15 Hours

UNIT – II

PROCESSING TECHNIQUES, RECOVERY OF RESOURCES AND WASTE DISPOSAL

Processing Techniques: Unit operations for separations and processing, mechanical and thermal volume reduction, Incineration of solid wastes – process and types of incinerators (liquid injection, rotary kiln and fluid bed), Biological processing – composting, vermicomposting, biomethanation, fermentation, Drying and dewatering of wastes.

Recovery of Resources: Heat recovery in incineration process, energy recovery and conversion of products from biological processes.

Dumping of solid wastes, Landfills – Types, site selection, preliminary design, operation, case study, Advantages and disadvantages of landfills, Leachate and landfill gases: Collection and treatment, Landfill disposal for hazardous wastes, biomedical waste.

16 Hours

UNIT – III

SOLID WASTE MANAGEMENT RULES AND PLANNING ISSUES

Legislative trends and impacts: Major legislations, Government agencies. Municipal Solid Waste Management Act (1999), Hazardous Wastes (Handling and Management) Rules, Biomedical Waste (Handling and Management) Rule (1998), e-Waste (Management and Handling) Rule 2011.

Planning and developing a site for solid waste management, Site Remediation: Assessment and Inspection, Remedial techniques, Siting guidelines.

8 Hours

Course Outcomes:

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

1. Identify the sources, classification and characteristics of solid wastes
2. Develop insight into the collection, transfer, and transport of solid waste.
3. Apply waste processing techniques and recovery of resources from the waste.
4. Select the alternatives of solid waste disposals and its impacts.
5. Acquire knowledge about solid and hazardous waste management legislative rules.

Mapping of POs & COs:

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

REFERENCE BOOKS:

1. Tchobanaglous, G., Theisen, H. and Vigil, S. A. *Integrated Solid Waste Management*, McGraw – Hill. 1993.
2. Tchobanoglous, G., Thiesen, H., Ellasen, *Solid Waste Engineering Principles and Management*, McGraw – Hill, 1997.
3. Landrefh, R. E. And Rebers, P. A. Lewis, *Municipal Solid Wastes-Problems & Solutions*, 1997.
4. Bhide, A. D. and Sundaresan, B. B. *Solid Waste Management in Developing Countries*, Indian National Scientific Documentation Centre. New Delhi, 2000.

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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NUMBER THEORY			
Course Code	**20MA8X43**	**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 the divisibility of integers ,study of prime numbers and basic properties of congruences.
2.	Study Fermat's little theorem and understand Euler's function.
3.	Study the existence of primitive roots and quadratic residues.
4.	Study the cryptographic applications in number theory.

UNIT - I

Divisibility and the theory of congruences

Division algorithm, Euclid's algorithm for the greatest common divisor. Linear Diophantine equations. Prime numbers, fundamental theorem of arithmetic. Basic properties of congruences, Linear congruences and Chinese reminder theorem.

15 Hours

UNIT - II

Fermat's theorem, Wilson's theorem, Euler's Phi function, Euler's theorem.

Primitive roots and Quadratic congruences 16 **Hours**

Order of an integer modulo n, primitive roots for primes, Euler's criterion, Legendre symbol and its properties

UNIT - III

Cryptography

Introduction to public key cryptography, RSA cryptosystem, an application of primitive roots to cryptography

8 Hours

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

1.	Use divisibility and Greatest common divisor in Euclidean algorithm. Solve Diophantine equations. Identify prime factorization of an integers.
2.	Understand the properties of congruences. Use Chinese reminder theorem to find solution of system of linear congruences
3.	Use Fermat's Little Theorem and Wilson's Theorem. Use of Euler's Phi function.
4.	Identify primitive roots of an integers. Apply Euler's criterion and Legendre symbols.
5.	Code and decode numbers in the RSA cryptosystem.

Course Outcomes Mapping with Program Outcomes & PSO

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

1: Low 2: Medium 3: High

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:

1.	Methods recommended: Two Tests (80%), Written Quiz (10%) and module assignments (10%).
2.	The class teacher must decide the topic for closed book test and Written Quiz. In the beginning only teacher must announce the methods of CIE for the subject.

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

TEXTBOOKS:	
1.	D. Burton; Elementary Number Theory, McGraw-Hill, 2005
2.	Niven, H.S. Zuckerman & H.L. Montgomery, Introduction to the Theory of Numbers, Wiley,2000.
REFERENCE BOOKS:	
1.	H. Davenport, The Higher Arithmetic, Cambridge University Press, 2008.
2.	G.A. Jones & J.M. Jones, Elementary Number Theory, Springer UTM, 2007.
3.	Thomas Koshy, Elementary Number Theory with Applications, 2nd edition, Elsevier, 2007
4.	Fundamentals of Number Theory by William J. LeVeque
E Books / MOOCs/ NPTEL	
1.	http://refkol.ro/matek/mathbooks/ro.math.wikia.com%2520wiki%2520Fisiere pdf incarcate/ Elementary-Number-Theory.pdf
2.	https://nptel.ac.in/courses/111104138
3.	https://nptel.ac.in/courses/111103020

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PCB DESIGN			
Course Code	**20EC8X59**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Pre-requisites:

Basic electrical and electronics engineering.

Course Learning Objectives:

1. To enable students to gain knowledge of Schematic Design techniques & PCB design techniques
2. To expose students to complete PCB Design & manufacturing process

List of Experiments

- Introduction to PCB design tool: building a schematic circuit and layout
- Exploring the PCB design tool by creating new components, using existing components and footprint, simulation features, Active & Passive Components
- Drawing a PCB layout in a single layer with constraints such as board area, track width, packages, via etc
- Creating a double layer PCB for a given schematic circuit
- Creating and using different component package types
- Fabrication of single and double layer PCB on a copper clad board using hatching/engraving technique.
- Handling PCB prototype machine using Mach3 CNC tool for the PCB prototype.

Detailed Course Plan

Lab 1

Introduction to PCB design tool : building a schematic circuit.

Lab 2

Creating Library & Components, using existing components and footprint, simulation features, Active & Passive Components.

Lab 3

Designing a single layer PCB for given schematic circuit diagram, Gerber file generation.

Lab 4
Designing a double layer PCB for given schematic circuit diagram, Gerber file generation.

Lab 5
Simulating digital and analog circuits for given test cases.

Lab 6
Handling programmable microcontroller circuit in the simulation environment of schematic editor .

Lab 7
Defining a footprint for a component in the PCB layout.

Lab 8
Fabrication of single layer PCB using PCB prototype machine – Generating bit filein Copper Cam tool.

Lab 9
Fabrication of single layer PCB using PCB prototype machine – Setting up Mach3 CNC tool.

Lab 10
Fabrication of double layer PCB using PCB prototype machine – Generating bit file in Copper Cam tool.

Lab 11
Fabrication of double layer PCB using PCB prototype machine -Setting up Mach3 CNC tool.

Lab 12
Component placement and soldering.

Lab 13
Desoldering and testing.

Scheme of SEE Examination
It is a 3-Hour exam at the end of the semester where the student is to demonstrate the PCB designing process.

Sl.No	Activity	Max. Marks
1	Creating schematic for a given circuit diagram	15
2	PCB Layout design	20
3	Setting up fabrication	15
Total		**50**

Course Outcomes:
At the end of the course the student will be able to
1. Draw schematic circuit and create PCB layout for single or multilayer PCB
2. Fabricate single and double-layer PCB using Mach3Mill operated CNC machine.

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INNOVATION AND ENTREPRENEURSHIP			
Course Code	**20ME8X63**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Prerequisites:
The student must have learnt basics of Engineering concepts, applications and business as a whole.

Course Learning Objectives: This Course will enable students to,

1	Understand Technological Innovation
2	Understand Innovation management and the difference between Invention and Innovation.
3	Appreciate the importance of Innovation as management process and Innovation management techniques.
4	Define Innovation system and Understand the importance of Technology management and Transfer.
5	Identify Technological Entrepreneurship and its types and Understand the Institutional support provided for Entrepreneurs

UNIT – I	
INTRODUCTION TO TECHNOLOGICAL INNOVATION	**14 Hours**
Basic Concepts and Definitions: Technology - Technology Management – Invention – Creativity – Innovation - The Concept of Technological Innovation - Innovation Posture, Propensity and Performance - Innovation Measurement - Key factors linking creativity and innovation – Classifications of Innovations – Innovation Process.	
INTRODUCTION TO INNOVATION MANAGEMENT	
Innovation Management Through Management of Knowledge and Education – Types of Learning - Difference Between Innovation and Invention - Types and Characteristics of Innovation.	
INNOVATION AND COMPETITIVENESS	
Case Study – Barriers for Innovation and Competitiveness.	
UNIT – II	
INNOVATION AS A MANAGEMENT PROCESS	**14 Hours**
Activities to enhance companies capacity for innovation – Management of Technological Innovation: Corporate Perspective, National Perspective, Theoretical Perspective and Individual Perspective - Challenges in Technological Innovation Management - Case Study in Technological Innovation Management - Innovation Management Techniques (IMTs).	
INNOVATION SYSTEMS	
The Concept of Innovation Systems - Innovation Systems: Sectoral, Regional, National.	
TECHNOLOGY MANAGEMENT AND TRANSFER	
Technology Transfer - Impacts of MNCs in technology transfer -	
UNIT – III	
INTRODUCTION TO TECHNOLOGICAL ENTREPRENEURSHIP	**11 Hours**
Types of Entrepreneurship: Mixed Entrepreneurship, Pure Entrepreneurship, Social Entrepreneurship, Collaborative Entrepreneurship, Internal Entrepreneurship, External Entrepreneurship - Sustainable Entrepreneurship -	
INSTITUTIONAL SUPPORT	
Business Incubator (Bi) - Determination of the Five Incubator Services - Incubation Centres in India – Atal Incubation Centre – Startup India - NSIC, KIADB, KSFC.	

Course Outcomes (CO):	
At the end of the course the student will be able to,	
CO 1	Describe technological innovation and its key features for business.
CO 2	Describe innovation management and difference between invention and innovation.
CO 3	Explain innovation as a management process, its management and perspectives. Understand Innovation management techniques.
CO 4	Explain innovation system, technology management and transfer.
CO 5	Explain technological entrepreneurship and institutional support.
TEXTBOOK:	
1	Carayannis, Elias G., Samara, Elpida T., Bakouros, Yannis L., "Innovation and Entrepreneurship Theory, Policy and Practice", Springer, 2015.
REFERENCE BOOKS:	
1	Dick Whittington, "Digital Innovation and Entrepreneurship", Cambridge University Press, 2018.

Course Articulation Matrix:

Course Code / Name : 20ME8X63/ INNOVATION AND ENTREPRENEURSHIP														
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C-20ME8X63.1	3	2				1	1		1			1	3	1
C-20ME8X63.2	3	2				1	1		1			1	3	1
C-20ME8X63.3	2	2				1	1		1			1	3	1
C-20ME8X63.4	2	2				1	1		1			1	3	1
C-20ME8X63.5	3	2				1	1		1			1	3	1

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

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

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AUTOMOTIVE ENGINEERING			
Course Code	**20ME8X65**	**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: 20ME8X65 / Automotive Engineering														
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C-20ME8X65.1	3	1	-	-	-	1	-	-	3	1	-	1	3	3
C-20ME8X65.2	3	1	-	-	-	1	-	-	3	1	-	1	1	3
C-20ME8X65.3	3	1	1	-	-	1	-	-	3	1	-	1	3	3
C-20ME8X65.4	2	3	1	-	-	1	-	-	3	1	-	1	2	3
C-20ME8X65.5	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	**20CV8X67**	**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

9 Hours

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:	**20HU8X68**	**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	**20HU8X70**	**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:

1. A. K. Uppal, “Physical Education and Health”
2. M. L. Kamlesh, “Fundamental Elements of physical Education”,
3. Swami Ramdev, “Yog its philosophy and practice”, Divya Prakashan
4. V. K. Sharma, “Health and Physical Education”

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INTRODUCTION TO JAPANESE LANGUAGE

Course Code	**20HU8X72**	**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

INTRODUCTION TO GERMAN LANGUAGE

Course Code	**20HU8X74**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical

Course Objectives:

1.	Distinguish - definite and indefinite articles, declension of singular and plural nouns by adding certain endings to them to differentiate between subjects, objects and indirect objects and construct sentences of simple day to day usage.
2.	Differentiate between nomnative and akkusative cases with transitive and intransitive verbs, and negation with Kein/e/er
3.	Differentiate use of dative object besides the subject for some specific verbs and Apply the grammar principles of use of personal pronoun as a substitute for noun as per the case, number and gender of the noun.
4.	Differentiate preposition forms when used exclusively in akkusative or Dative forms or on combination of the two cases
5.	Differentiate conjugation of verbs in present, present-perfect and past participle tenses, separable and inseparable verbs, application of conjugation of modal verbs and position of modal verb in a sentence.

UNIT - I	
Introduction: Mein Name ist (saying who you are, greeting people and saying goodbye, asking people where they come from and where they live. Language point: I and you), Lesen der politischenKarte der Welt, Nationalitaeten und Spachen, Die Uhrzeit (The time) telling time and talking about daily routine, Tage der Woche, die Monate, die vierJahreszeiten, die Jahre Mir gehtes gut: Asking people how they are, saying how you are, saying which cities and counries people come from, Language points: verb endings), Wieschreibt man das (how do you write that?) Counting from 1-100 and above, alphabet, spelling our names and words, talking about us and them. Language points: Yes-no questions Artikel (Articles): As in English, there are definite (der/die/das) and indefinite (ein/eine) articles: the □ der/die/das; a/an □ ein/eine Die vierFälle (The four cases): Nominativ, Akkusativ, Dativ, Genitiv(Not in level A-1) Deklination des bestimmtenArtikels der/die/das Deklination des unbestimmtenArtikelsein/eine (Deklination/Declension: the variation of the form of a noun, pronoun, or adjective, by which its grammatical case, number, and gender are identified) Deklination von Substantiven (Declension of nouns) (Singular and Plural) (German nouns are declined by attaching certain endings to them, according to case, number and gender. This helps to differentiate between subjects, objects and indirect objects). Nominativ und Akkusativ(nominative and accusative cases) The verb determines the case of the noun. Some verbs only go with the nominative, others only with the accusative (or the dative). Thus, German verbs are either transitive or intransitive. (Nominative and accusative cases) Intransitive Verben (intransitive verbs) Transitive Verben (transitive verbs) Negation „kein/e/er "(negation with „kein/e/er ") (Singular und Plural) The negation of the indefinite article (ein/eine/ein) is kein/keine/kein. For this, you just have to put a „k" at the beginning of the declined form of ein/eine/ein. Peter siehteinHaus. □ Negation □ Peter siehtkeinHaus. (Peter sees a house. □ negation □ Peter does not see a house.) (With examples, writing and hearing exercises, and German to English Glossary as applicable)	13
UNIT - II	
Dativ (the dative) (You are already familiar with verbs which require a direct accusative object in addition to the subject, which is in the nominative case. But there also some verbs which require a dative object besides the subject. To identify the dative object you ask "(To) whom?") Der Plural (the plural) There are many different forms of the plural in the German language. Principally, the gender and the ending of the noun determine the plural form. Then, you either attach a plural ending to the noun, change a vowel, or keep the noun as it is in the singular. Das Personalpronomen (the personal pronoun) The personal pronoun is a substitute for a noun. Its forms are determined by the case, number and gender of the noun which is to be replaced. Die Formen des Personal pronomenimNominativ (The nominative forms of the personal pronoun): Präpositionen (prepositions) German prepositions are followed by an object, either in the accusative or the dative case. Some prepositions always take an accusative object, others always a dative object. But there are also prepositions which can be followed by both. In this case, the question "Where(to)?" (□ accusative) or "Where?" (□ dative) determines the case of the object. PräpositionenmitAkkusativ und Dativ (Prepositions with accusative and dative) 1. PräpositionenmitAkkusativ (prepositions with accusative) 2. PräpositionenmitDativ (prepositions with dative) 3. PräpositionenmitAkkusativoderDativ (prepositions with accusative or dative)	13

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

UNIT - III

Konjugation von VerbenimPräsens (Conjugation of verbs in present tense) Verbs are conjugated by attaching certain endings, depending on the person and number of the subject. Trennbare und untrennbareVerben (separable and inseparable verbs) Verbs with prefixes are dinstinguished between separable and inseparable verbs. The prefix of an inseparable verb must never be separated from the stem. Here the stress is on the stem: be-kommen. The prefix of a separable verb gets separated from the stem when the verb is conjugated. In the infinitive, the stress is on the prefix: an-kommen 1. TrennbareVerben (separable verbs) 2. UntrennbareVerben (inseparable verbs) Konjugation von VerbenimPerfekt (Conjugation of verbs in present perfect) The present perfect (Perfekt) describes something which happened in the past and is especially used in spoken German. It is formed with the present tense form of „haben“ or „sein“ and the past participle of the main verb. 1. Die Bildung des Partizips (the formation of the past participle) 2. Die Bildung des Perfektsmit „haben“ und „sein“ (the formation of the present perfect with „haben“ and „sein“) Modalverben (modal verbs) A modal verb is rarely used as a main verb; instead, it usually modifies the main verb. While the main verb remains in the infinitive, the modal verb is conjugated. In German, there are 7 modal verbs: können (can/be able), dürfen (may/be allowed), wollen (want), müssen (must/have to), sollen (shall), mögen (to like), möchten (wish/would like) 1. Konjugation der Modalverben (Conjugation of the modal verbs) 2. Stellung des ModalverbsimSatz (Position of the modal verb within a sentence) (With examples, writing and hearing exercises, and German to English Glossary as applicable)	13

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

1.	Distinguish - definite and indefinite articles, declension of singular and plural nouns by adding certain endings to them to differentiate between subjects, objects and indirect objects and construct sentences of simple day to day usage.
2.	Differentiate between nomnative and akkusative cases with transitive and intransitive verbs, and negation with Kein/e/er
3.	Differentiate use of dative object besides the subject for some specific verbs and Apply the grammar principles of use of personal pronoun as a substitute for noun as per the case, number and gender of the noun.
4.	Differentiate preposition forms when used exclusively in akkusative or Dative forms or on combination of the two cases
5.	Differentiate conjugation of verbs in present, present-perfect and past participle tenses, separable and inseparable verbs, application of conjugation of modal verbs and position of modal verb in a sentence.

Course Outcomes Mapping with Program Outcomes & PSO

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

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Ulrich Haessermann, Georg Dietrich, Christianne C. Guenther, Diethelm Kaminski, Ulrike Woods and Hugo Zenker, Sprachkurs Deutsch Neusaffung 1, UnterrichtswerkfuerErwachsene, Verlag Moritz Diesterweg, Universitaetsdruckerei H. Stuertz AG Wuerzburg, 1989
2.	Paul Coggle and HeinerSchenke, Teach Yourself German (a complete course in understanding, speaking and writing), Teach Yourself Books, Hodden& Stoughton Educational, UK, 2001
3.	Langenscheidt German In 30 Days: Book + Cd Paperback, www.amazon.in, – 1 September 2011

REFERENCE MATERIALS:

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

E-RESOURCES:

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

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SUSTAINABLE DEVELOPMENT GOALS

Course code	**20ME8X75**	**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 : 20ME/ 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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WEB TECHNOLOGIES			
Course Code	**20IS8X76**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives (CLOs):

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

- Illustrate the Semantic Structure of HTML and CSS
- Compose forms and tables using HTML and CSS
- Design Client-Side programs using JavaScript and Server-Side programs using PHP
- Illustrate the Database connectivity using PHP
- Examine JavaScript frameworks such as jQuery

UNIT - I

Introduction to HTML- Html tags and simple HTML forms, web site structure, HTML table, Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colours and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.

15 Hours

UNIT - II

Client side Scripting: Introduction to JavaScript: JavaScript language – declaring variables, scope of variables functions, event handlers (on click, on submit etc.), Document Object Model, Form validations. Introduction to PHP: Declaring variables, data types, arrays, strings, operations, expressions, control structures, functions, Reading data from web form controls like Text Boxes, radio buttons, lists etc.,

15 Hours

UNIT – III

PHP Databases: Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, File Handling in PHP, PHP Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal Arrays, jQuery Introduction: What is jQuery, Adding jQuery in to your web pages, jQuery Syntax, jQuery Selectors, jQuery Events.

9 Hours

Course Outcomes:

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

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

Mapping Course Outcomes with Programme Outcomes:

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

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

TEXTBOOK:

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

E RESOURCES:

1. nptel.ac.in/courses/106105084/11

SEE Question Paper Pattern:

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

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PROGRAMMING IN JAVA			
Course Code	**20CS8X77**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable students to:

1. Learn fundamental features of object oriented language and JAVA programming constructs.
2. Develop and run simple Java programs using OOPS concepts of java
3. Create multi-threaded programs and event driven Graphical User Interface (GUI) programming using swing package.

UNIT – I

Introduction to Java: Java's magic: The Byte code; Java Development Kit (JDK); the Java Buzzwords, Object-oriented programming; Simple Java programs. Data types, variables and arrays, Operators, Control Statements.

Classes, Inheritance: Classes fundamentals; Declaring objects; Call by value and Call by Reference, array of objects, Constructors, this keyword, and usage of static keyword.
Inheritance: inheritance basics, using super, creating multi-level hierarchy, method Overriding, abstract classes, final classes.

15 Hours

UNIT – II

Exception handling, packages and interfaces: Exception handling in Java, use of try, catch blocks, multiple catch blocks, finally block, use of throw and throws clauses, creating custom exceptions. Packages, Access Protection, Importing Packages, Interfaces. IO Streams for file handling.

Multi-Threaded Programming:
What are threads? How to make the classes threadable; Extending threads; Implementing runnable interface; creating multiple threads, join and is Alive methods of Thread class, Thread Synchronization; achieving thread synchronization among multiple threads. Thread priorities, methods to get and set thread priority

15 Hours

UNIT – III

Event Handling: Two event handling mechanisms; The delegation event model; Event classes; Sources of events; Event listener interfaces; Using the delegation event model;

Swings:
The origins of Swing; Two key Swing features; Components and Containers; The Swing Packages; A simple Swing Application; Create a Swing Applet; Jlabel and ImageIcon; JTextField; The Swing Buttons; JTabbedpane; JScrollPane; JList; JComboBox; JTable.

09 Hours

Course Outcomes:
Upon completion of this course, students will be able to:

1. Apply the object-oriented concepts to solve real world problems using JAVA programming features
2. Illustrate the basic constructs and object orients features of the Java language
3. Design a multi-threaded program using Java with exception handling
4. Develop Java programs that includes packages and interfaces and preform file operations in Java
5. Develop simple GUI interfaces for a computer program to interact with users, and to understand the event-based GUI handling principles using swings

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

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

Graduate Attributes (GA)
This course will map the following GA as per NBA:

1. Design/Development of Solutions
2. Problem Analysis
3. Modern tool usage

TEXTBOOK:

1.Herbert Scheldt, Java the Complete Reference, 7th Edition, Tata McGraw Hill, 2007. (Chapters 2-11, 22-24, 29,30)

REFERENCE BOOKS:

1. Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, Pearson Education, 2008, ISBN:9788131720806
2. Rajkumar Buyya,S Thamarasi selvi, xingchen chu, Object oriented Programming with Java, Tata McGraw Hill education private limited.
3. Richard A Johnson, Introduction to Java Programming and OOAD, CENGAGE Learning.
4. E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies.

E-Books / Online Resources:

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

MOOC:

1. Oracle: *www.oracle.com/events/global/en/java.../java-a-beginners-guide-1720064.pdf*
2. NPTEL:*www.nptelvideos.com/java/java_video_lectures_tutorials.php*

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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DATA STRUCTURES AND ALGORITHMS			
Course Code	**20CS8X78**	**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 concepts of data structures, its types, structures and pointers.
2. **Understand** linear data structures, namely, stack, queue, singly linked list and doubly linked list.
3. **Analyze** nonlineardata structures, namely, binary tree and graphs.
4. **Analyze** the non-recursive and recursive algorithms and to represent Efficiency of these algorithms in terms of the standard Asymptotic notations.
5. **Explain** the various algorithm design techniques and apply them to solve various real world problems.

UNIT – I

INTRODUCTION:

Data Structure, Classification (Primitive and non-primitive), data structure operations.

POINTERS:

Definition and Concepts, Accessing variables through pointers, Arrays and pointers. Structures, pointers to structures.

LINEAR DATA STRUCTURES – STACKS:

Introduction and Definition, Representation of stack: Array and structure representation of stacks, Operations on stacks using C functions (Push(), Pop(), IsStackFull(), IsStackEmpty()).

LINEAR DATA STRUCTURES – QUEUES:

Introduction and Definition Representation of Queue: Array and Structure representation of queue, Operations on Ordinary Queue using C functions (Insert(), Remove(), IsQueueFul(), IsQueueEmpty())

15 Hours

UNIT – II

LINEAR DATA STRUCTURES - SINGLY LINKED LISTS:

Dynamic Memory allocation functions. Definition and concepts singly linked List: Representation of link list in memory, Operations on singly Linked List using C functions (Insert node at front, Remove a node from front, display singly linked list).

LINEAR DATA STRUCTURES - DOUBLY LINKED LISTS:

Doubly Linked List: Representation. (Operations not included).

NONLINEAR DATA STRUCTURES – BINARY TREES:

Binary Trees: Properties, Linked representation of Binary Tree, Binary Tree Traversals, Introduction to Binary Search Tree.

INTRODUCTION TO ALGORITHMS:

What is an Algorithm? Fundamentals of Algorithmic Problem Solving, understanding and representing graphs using adjacency matrix and linked list.

FUNDAMENTALS OF THE ALGORITHMS EFFICIENCY:

Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms.

15 Hours

UNIT – III

DECREASE & CONQUER:

Concept of Decrease and Conquer, Graph traversal algorithms - Depth First Search, Breadth First Search.

DYNAMIC PROGRAMMING:

Concept of Dynamic Programming, Computing a Binomial Coefficient.

GREEDY METHOD:

Concept of Greedy technique, Prims algorithm.

BACKTRACKING:

Concept of Backtracking technique, N-Queens problem.

9 Hours

Course Outcomes:

1. **Acquire** the fundamental knowledge of various types of data structures and pointers using that knowledge, analyze and design the programs using pointers
2. **Apply** the fundamental programming knowledge of data structures to analyze and design linear data structures, namely, stack, queue, singly linked list and doubly linked list and use them for solving problems.
3. **Implement** and apply the concept of binary trees and graph data structures and also understand their traversals.
4. **Analyze** non-recursive or recursive algorithm and to represent in terms of standard Asymptotic notations.
5. **Apply** Divide and Conquer, Decrease and Conquer, Dynamic programming, Greedy, and Backtracking algorithm design techniques to solve real time problems.

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	2						1				1	3		
CO2	3	1	2					1				1	3		
CO3	3	2						1				1	3		
CO4	2	3												2	
CO5	2	2	3	2	3				1			1		3	

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

TEXTBOOKS:

1. Aaron M. Tenenbaum, Yedidyah Langsam & Moshe J. Augenstein, “Data Structures using C”, Pearson Education/PHI, 2006.
2. Anany Levitin, “Introduction to the Design & Analysis of Algorithms”, 2nd Edition, Pearson Education, 2007.

REFERENCE BOOKS:

1. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd edition, Universities Press, 2014.
2. Seymour Lipschutz, "Data Structures, Schaum's Outlines", Revised 1st edition, McGraw Hill, 2014.
3. Thomas H. Cormen, Charles E.Leiserson, Ronal L. Rivest, Clifford Stein, "Introduction to Algorithms", 2nd Edition, PHI, 2006.

MOOCs:

1. Introduction to Data Structures by edx , URL: https://www.edx.org/course/
2. Advance Data Structures by MIT OCW , URL: https://www.mooclab.club/
3. Data Structure by Harvard Extension School, URL: http://www.extension.harvard.
4. http://nptel.ac.in/courses/106101060/

SEE SCHEME:

There will be **8** questions of **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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ELECTRIC VEHICLE TECHNOLOGY			
Course Code	**20EE8X79**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

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

Course Learning Objectives:

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

UNIT – I

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

Electric and Hybrid Electric Vehicles: Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains. **14 Hours**

UNIT – II

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

Electric Propulsion:

EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives. **16 Hours**

UNIT – III

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

9 Hours

Course Outcomes:

At the end of the course student will be able to

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

Course Outcomes Mapping with Program Outcomes & PSO												
Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
20EE8X .1	2	3										
20EE 8X .2	1	2	3									
20EE 8X .3	1	2	3									
20EE 8X .4	1	2	3									
20EE 8X .5	1	2	2									

1: Low 2: Medium 3: High

SEE QUESTION PAPER PATTERN:

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

TEXTBOOKS:

1. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Husain, CRC Press, 2003
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, M. Ehsani, Y. Gao, S.Gay and Ali Emadi, CRC Press, 2005

REFERENCE BOOKS:

1. Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Sheldon S. Williamson, Springer, 2013.
2. Modern Electric Vehicle Technology, C.C. Chan and K.T. Chau, OXFORD University, 2001
3. Hybrid Electric Vehicles Principles And Applications With Practical Perspectives, Chris Mi, M. Abul Masrur, David Wenzhong Gao, Wiley Publication, 2001

E-Books / MOOC:

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

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INTERNET OF THINGS – (IoT)			
Course Code	**20CS8X80**	**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.**

NATIONAL CADET CORPS: ORGANIZATION, FUNCTIONS AND CAPABILITIES

Course Code	**20HU8X81**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Chemistry

Course Learning Objectives:

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

UNIT – I

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

UNIT – II

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

UNIT – III

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

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

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

Course Outcomes Mapping with Program Outcomes & PSO

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

1: Low 2: Medium 3: High

REFERENCE BOOKS:

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

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FUNDAMENTALS OF IMAGE PROCESSING – A PRACTICAL APPROACH			
Course Code	**20EC8X82**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:0:1**	**SEE Marks**	**50**
Total Hours	**26:0:26**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

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

Software Tool Required: MATLAB

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

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

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

26 Hours

List of Experiments:

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

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

Scheme of SEE
Laboratory based evaluation

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

1. Demonstrate the understanding of basic operations on images
2. Apply image enhancement methods
3. Perform segmentation operation

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

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

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. R. C. Gonzalez and R. E Woods, "**Digital Image Processing**", Pearson education (Asia)/Prentice Hall of India, 3rd Edition, 2009.
2. R. C. Gonzalez and R. E Woods, "**Digital Image Processing Using MATLAB**", Pearson education (Asia)/Prentice Hall of India, 2nd Edition, 2011.
3. 1.S. Jayaraman, S Esskairajan "**Digital Image Processing**", illustrated, Tata McGraw-Hill Education,2011.

NPTEL/ MOOC Link:

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

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SOFTWARE ENGINEERING PRACTICES			
Course Code	**20IS8X83**	**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	**20IS8X84**	**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	**20EC8X85**	**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,launchingintoouter 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

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INTRODUCTION TO YAKSHAGANA			
Course Code	**20HU8X86**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning objectives:

The course will enable the students to:

1. Gain basic understanding of Thenku Thittu Yakshagana.
2. Perform basic movements.
3. Understand speech/dialogue, rhythm, Entry and improvisation skills.

UNIT – I

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

14 Hours

UNIT – II

Thalas- Rupaka Thala, Trivide Thala, Jampe thala etc. with biditha and mukthaya.

Dhigina – Practice
Rangasthala Pravesha steps and Eripada ettugade steps.
Revision of all Thalas. ……

14 Hours

UNIT – III

Yakshagana Prasanga Practice- Abhinaya and presentation……..

11 Hours

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

REFERENCE BOOKS:

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

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MARKETING MANAGEMENT			
Course Code	**20ME8X88**	**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
CO 2	Interpret the buying behaviour of customers and role of marketing segments
CO3	Explain the role of product pricing and marketing research in the competitive global business environment
CO4	Analyse the marketing plans and strategies.
CO5	Explain the role of sales, advertising and distribution in marketing to achieve thegoals of marketing

TEXTBOOK:

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

REFERENCE BOOKS:

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

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