RAMAIAH
Institute of Technology

CURRICULUM

Academic Year 2026 – 2027

III & IV SEMESTER B.E.

MECHANICAL ENGINEERING

Batch 2025

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Approved by AICTE, New Delhi &Govt. of Karnataka
Accredited by NBA &NAAC with A^{+}Grade

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 18 UG programs and 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with an **'A^{+}' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute has also been conferred autonomous status for Ph.D. program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 70% are doctorates. Some of the distinguished features of MSRIT are: State-of-the-art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency Systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation.

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. The Institute is a member of DELNET, CMTI and VTU E-Library Consortium. The Institute has a modern auditorium, recording studio, and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, Ramaiah Institute of Technology has achieved 75th rank among 1584 top Engineering Institutions & 31st Rank among 131 Architecture Institutions, for the year 2025.

About the Department:

The Department of Mechanical Engineering started in the year 1962 with an intake of 40 students. The department has grown strong over the last 63 years and today has an intake of 120 students and 31 teaching staff. All the faculty members are well qualified and possess post graduate degree with 24 doctorates. The department offers four-year degree course and offers one Master Degree in Robotics and Artificial Intelligence, with an intake of 18. The Department also offers research program which includes MSc Engineering by research and PhD degree from Visvesvaraya Technological University and at present 26 researchers are pursuing PhD. The faculty members have taken up number of research projects funded by external agencies like DRDO, DST, AICTE, IIT Indore, SERB, VGST and Visvesvaraya Technological University and received funding more than Rs 1.4 Crores. The department has exemplified its dedication to scholarly advancement by organizing a national-level project exhibition and convening esteemed international conferences, including the International Conference on Recent Advances in Engineering Sciences (ICRAES) and the International Conference on Mechanics of Advanced Materials and Structures (ICMAMS). These initiatives have served as pivotal forums for intellectual discourse, fostering innovation and facilitating the dissemination of cutting-edge research within the academic community. Faculty members from the department have published books on different domains of Mechanical Engineering and are recommended by Visvesvaraya Technological University Board of Studies as reference text books.

The department consistently fosters and facilitates student participation in technical competitions and projects to advance their academic expertise and professional development.

Team EDITHA participated in the Student Unmanned Aerial System (SUAS) competition held in Maryland, California, USA, from June 24th to 26th, 2025. The team distinguished itself by securing an overall fourth place, accompanied by a prize award of USD 1,000, as well as achieving third place in the technical design report category.

The department has achieved significant recognition through its team, CO2 - Velocita Racing, at the Formula Bharat 2025 competition held at Kari Motor Speedway, Coimbatore, from January 22 to 27, 2025. The team secured an overall 2nd place in the combustion category, demonstrating excellence across multiple events including Engineering Design (2nd place), Acceleration (winner), Autocross (winner), and Skidpad (winner). Their outstanding performance earned them a total overall score of 538.41 points with no penalties, reflecting their technical expertise and innovative engineering capabilities. This achievement underscores the department’s commitment to fostering high-level competitive skills, practical engineering application, and collaborative innovation among its students.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

1. Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
2. Establishing research clusters in emerging areas in collaboration with globally reputed organizations
3. Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at M S Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To be a centre of international repute in Mechanical Engineering and to create qualified human resources needed to meet the demanding challenges in different areas and emerging fields of Mechanical Engineering and allied sciences.

MISSION OF THE DEPARTMENT

To impart quality technical education to meet the growing needs of the profession through conducive and creative learning environment, to produce qualified and skilled human resources, create R&D environment, to be a center of excellence and to offer post graduate programs in the emerging fields of Mechanical Engineering.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

- To produce engineers with sound basic theoretical knowledge along with required practical skills in various specialized fields of Mechanical Engineering.
- To inculcate team work capabilities and communication skills among students through co-curricular activities.
- To motivate students for higher studies in specialised areas of Mechanical Engineering and explore possible professions in R&D, academic and self-employment opportunities.
- To bring in awareness on environmental issues and commitments towards Professional ethics, social responsibilities and need for lifelong learning

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

PROGRAM OUTCOMES (POs):

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

PSOs OF THE PROGRAM OFFERED:

Mechanical Engineering Graduates will be able to:

PSO1: Ability to apply their knowledge in engineering mechanics, materials science, design, thermal engineering, production, management, CAD/CAM, robotics - on an applied basis.

PSO2: Ability to apply the learned principles to the analysis, design, development and implementation to advanced mechanical systems and processes, be prepared to work professionally in Mechanical Engineering domain.

Semester wise Credit Breakdown for B.E Degree Curriculum Batch -2025

Semester / Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Applied Science Course ASC(IC)	8	8	03	00	-	-	-	-	22
Emerging Technology Course (ETC)	3	-	-	-	-	-	-	-	03
Programming Language Course (PLC)	-	3	-	-	-	-	-	-	03
Engineering Science (ESC)	5	5	--	--	--	--	--	--	10
Humanities, Social Sciences and Management Course (HSMC)	2	2	--	--	03	03	--	--	10
Ability Enhancement Course (AEC)	2	2	01	01	01	01	02	--	10
Universal Human Values (UHV)	--	--	02	--	--	--	--	--	02
Professional Core Course (PCC)	--	--	11	12	12	06	04	--	45
Professional Core Course (IC)	--	--	04	04	03		04	--	15
Professional Elective Course (PEC)	--	--	--	03	03	06	03	--	12
Open Elective Course (OEC)	--	--	--	--	--	03	03	--	06
Internship (INT)	--	--	--	✔	--	--	--	05	05
Mini Project / Project Work (PW)	--	--	--	--	--	04	--	13	17
Non-Credit Mandatory Course (NCMC)	--	--	--	--	✔	--	--	✔	--
Total Credits	20	20	21	20	22	23	16	18	160

B.E. in Mechanical Engineering Scheme of Teaching Batch -2025												
III SEMESTER												
Sl. No.	**Course Code**	**Course**	**Teaching Department**	**Category**	**Credits**				**Total contact hours /week**			
					L	**T**	**P**	**Total**	**L**	**T**	**P**	**S**
1	ME31	Statistics,Probabality Distributors and Integral Transforms	Mathematics	ASC	2	1	0	3	2	2	0	2
2	ME32	Manufacturing Process I	Mechanical	PCC(IC)	3	0	1	4	3	0	2	3
3	ME33	Basic Thermodynamics	Mechanical	PCC	3	0	0	3	2	0	0	3
4	ME34	Mechanics of Materials	Mechanical	PCC	3	0	0	3	2	0	0	3
5	ME35	Material Science & Metallurgy	Mechanical	PCC	3	0	0	3	3	0	0	3
6	UHV36	Universal Human Value Course	Mechanical	UHV	2	0	0	2	2	0	0	2
7	MEAEC37	Indian education system	Mechanical	AEC	1	0	0	1	1	0	0	1
8	MEL38	Materials Testing Laboratory	Mechanical	PCC	0	0	1	1	0	0	2	0
9	MEL39	Computer Aided Machine Drawing	Mechanical	PCC	0	0	1	1	0	0	2	0
Total					**17**	**1**	**3**	**21**	**17**	**2**	**6**	**17**
11	PE69	Physical Education		NCMC			All students have to register compulsorily for any one of the courses with the concerned coordinator (Yoga Teacher/ Physical Education Director/ NSS Coordinator) in the beginning of the III semester. Attending the registered course from III to VI semesters. Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree.					
	YO69	Yoga										
	NS69	NSS										
12	AM31	Additional Mathematics - I *		NCMC	0	0	0		0			

NOTE: Minimum of 1 subject should have a Tutorial component of 1 Credit.

Nomenclature: ASC: Applied Science Course, **IC:** Integrated Course (Practical Integrated with Theory Course), **PCC:** Professional Core Course, **UHV:** Universal Human Value Course, **AEC:** Ability Enhancement Course, **NCMC:** Non-credit Mandatory Course

Credit Definition:

- **1 credit = 1 hour/week of lecture (L)**
- **1 credit = 2 hours/week of tutorial (T)**
- **1 credit = 2 hours/week of practical(P)**
- **Self-Learning Hours (S)**

PCC & ASC courses are theory courses with or without tutorial sessions.

- Each theory credit corresponds to one contact hour per week, while each tutorial credit corresponds to two contact hours per week.
- The course shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.
- The CIE is evaluated for 50 marks through internal tests (30 marks) and other components (20 marks). Each internal test will have three questions and students shall answer any two full questions. Each question shall address all the Course Outcomes (COs) prescribed for that test. The average of the two tests shall be considered for awarding 30 marks. The remaining 20 marks shall be assessed through assignments, tutorial tests, quizzes, surprise tests, mini-projects, or other components as decided by the course instructor.
- The SEE examination shall consist of ten questions with internal choice (two questions per unit). Students shall answer any five full questions, selecting at least one question from each unit.

PCC (IC) is an Integrated course, combining theory with practical components.

- Theory sessions shall be conducted for 3 hours per week, while the practical sessions shall be conducted for 2 hours per week.
- Theory components shall be evaluated through both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE).
- The practical component shall be assessed only through CIE (No SEE).
- The CIE is evaluated for 50 marks through internal tests (30 marks) and other components (20 marks). Each internal test will have three questions and students shall answer any two full questions. Each question shall address all the Course Outcomes (COs) prescribed for that test. The average of the two tests shall be considered for awarding 30 marks. The remaining 20 marks shall be assessed through assignments, tutorial tests, quizzes, surprise tests, mini-projects, or other components as decided by the course instructor.
- The SEE examination shall consist of ten questions with internal choice (two questions per unit). Students shall answer any five full questions, selecting at least one question from each unit.
- However, questions from the practical component of the Integrated course (IC) can be included in the SEE question paper.

AEC is a 1-credit course involving 1 contact hour per week. The course shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.

- The CIE will comprise of two tests of 30 marks each having Part-A with MCQs for 6 marks and Part-B with Descriptive questions. The remaining 20 marks shall be assessed through assignments, surprise tests, quizzes, or other components as decided by the course instructor.
- The SEE will comprise of Part-A with MCQs (10 marks) and Part-B (5x8=40 marks) with descriptive questions.

UHV is a 2-criedit course involving 2 contact hours per week. The course shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.

- The CIE is evaluated for 50 marks through internal tests (30 marks) and other components (20 marks). Each internal test will have three questions and students shall answer any two full questions. Each question shall address all the Course Outcomes (COs) prescribed for that test. The average of the two tests shall be considered for awarding 30 marks. The remaining 20 marks shall be assessed through assignments, tutorial tests, quizzes, surprise tests, mini-projects, or other components as decided by the course instructor.

The SEE examination shall consist of ten questions with internal choice (two questions per unit). Students shall answer any five full questions, selecting at least one question from each unit.

PCC Laboratory is a 1-credit lab course involving 2 hours of lab sessions per week and uses both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) for assessment.

- CIE totals 50 marks, with 30 marks for lab sessions (Each laboratory experiment shall be evaluated for 10 marks based on the experiment record, conduction of the experiment, and observations, and the cumulative marks shall be scaled down to 30 marks.). Another 15 marks from a lab test and 05 marks for viva.
- SEE totals 50 marks, comprising 40 marks for procedure write up, experiment conduction & results and 10 marks for viva voce.

The Non Credit Mandatory Course, Physical Education (Sport and Athletics)/Yoga/National Service Scheme (NSS):

1. Student shall select any one of the NCMC's namely, Physical Education (Sport and Athletics)/Yoga/ NSS prescribed for four semesters and shall attend the course from the III semester to VI semester to complete all the formalities of the course and earn requisite CIE score. The Pass/Fail shall be reflected in the VI semester grade card.
2. The above mentioned NCMC's shall not be considered for vertical progression as well as for the calculation of SGPA/CGPA but completion of the courses shall be mandatory for the award of degree.
3. CIE marks will be allotted by the concerned course teacher based on attendance and performance in the practice sessions/field work every semester (III to VI) for 100 marks and the total 400 marks scored by the student are scaled down to 100 in the VI semester.
4. In case, any student fails to secure the minimum 40% of the prescribed marks, he/she shall be deemed to have secured 'F' grade.

*** Lateral Entry Students:**

The Non-Credit Mandatory Course, Additional Mathematics I: is prescribed for III Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other III semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured 'F' grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE. Incase student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. Additional Mathematics I shall have CIE component only and no SEE component. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

Lateral Entry Students:

The Non-Credit Mandatory Course, Inter/Intra Institutional Internship: All the students admitted under lateral entry category shall have to undergo a mandatory Internship of 02 weeks during the intervening vacation of III and IV semesters. Summer Internship shall include Inter / Intra Institutional activities. A Viva-voce examination shall be conducted during IV semester based on which a student will be declared pass or fail. The internship shall be considered as a head of passing for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete internship requirements during subsequent semesters.

Lateral Entry Students:

AICTE Activity Points Requirement for BE Programs: As per AICTE guidelines (refer Chapter 6 – *AICTE Activity Point Program, Model Internship Guidelines*), in addition to academic requirements, students must earn a specified number of **Activity Points** to be eligible for the award of the degree. The points to be earned is:

1. **Regular students** admitted to a 4-year degree program must earn **100 Activity Points**.
2. **Lateral entry students** (joining from the second year) must earn **75 Activity Points**.
3. **Students transferred** from other universities directly into the V semester must earn **50 Activity Points** from the date of entry into VTU.

These Activity Points are non-credit and will not be considered for the SGPA/CGPA or be used for vertical progression. However, earning Activity Points is mandatory for the award of the degree, and the points earned will be reflected on the eighth semester Grade Card. If a student completes all the semesters (eight or six) at the end of the program but fails to earn the required Activity Points, the VIII semester Grade Card will be withheld until the requirement is fulfilled. Also, the degree will be awarded only after the Grade Card has been released. The hours spent earning the activity points will not be counted for regular attendance requirements. Students can accumulate these points at any time during their program period, including weekends, holidays, and vacations, starting from the year of admission, provided they meet the minimum hours of engagement prescribed for each activity by AICTE.

B.E. in Mechanical Engineering Scheme of Teaching Batch -2025												
IV SEMESTER												
Sl. No.	**Course Code**	**Course**	**Teaching Department**	**Category**	**Credits**				**Total contact hours /week**			
					L	**T**	**P**	**Total**	**L**	**T**	**P**	**S**
1	ME41	Machine Design-I	Mechanical	PCC(IC)	3	0	1	4	3	0	2	3
2	ME42	Applied Thermodynamics	Mechanical	PCC	3	0	0	3	3	0	0	3
3	ME43	Mechanical Measurements & Metrology	Mechanical	PCC	3	0	0	3	3	0	0	3
4	ME44	Manufacturing Process II	Mechanical	PCC	3	0	0	3	3	0	0	3
5	MEE45x	Program Elective course-1	Mechanical	PEC	3	0	0	3	3	0	0	3
6	MEAEC46	Fundamentals of sensors and actuators	Mechanical	AEC	1	0	0	1	1	0	0	1
7	MEL47	Applied Thermodynamics Laboratory	Mechanical	PCC	0	0	1	1	0	0	2	0
8	MEL48	Mechanical Measurements & Metrology Laboratory	Mechanical	PCC	0	0	1	1	0	0	2	0
9	MEL49	Manufacturing Process Laboratory	Mechanical	PCC	0	0	1	1	0	0	2	0
Total					**16**	**0**	**4**	**20**	**16**	**0**	**8**	**16**
11	INT410	Inter /Intra Institutional Internship		NCMC								
	AM41	Additional mathematics II										

LIST OF COURSES OFFERED UNDER PROGRAM ELECTIVE COURSE -1 CREDITS: 3:0:0

Sl. No.	Subject Code	Subject
1	MEE451	Fluid Mechanics
2	MEE452	Cryogenics
3	MEE453	Theory of Elasticity
4	MEE454	Machine tool Design
5	MEE455	Tool Engineering
6	MEE456	Non Traditional Machining

NOTE: Minimum of 1 subject should have a Tutorial component of 1 Credit.

Nomenclature: IC: Integrated Course (Practical Integrated with Theory Course), **PCC:** Professional Core Course, **PEC:** Professional Elective Course, **AEC:** Ability Enhancement Course, **NCMC:** Non-credit Mandatory Course

Credit Definition:

- **1 credit = 1 hour/week of lecture (L)**
- **1 credit = 2 hours/week of tutorial (T)**
- **1 credit = 2 hours/week of practical(P)**
- **Self-Learning Hours (S)**

PCC(IC) is an Integrated course, combining theory with practical components.

- Theory sessions shall be conducted for 3 hours per week, while the practical sessions shall be conducted for 2 hours per week.
- Theory components shall be evaluated through both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE).
- The practical component shall be assessed only through CIE (No SEE).
- The CIE shall consist of two internal test of 30 marks each. Each test will have three questions and student shall answer any two full questions. Each question shall have all CO's addressed for that test. An average of two test shall be taken to award 30 marks.
- The CIE shall have other component for 20 marks assessed through assignments, quiz, surprise test, etc. as decided by the instructor of the course.
- The SEE examination shall consist of 10 questions with internal choice and student shall answer any five full questions.
- However, questions from the practical component of the Integrated course (IC) can be included in the SEE question paper.

PCC & PEC courses are theory courses with or without tutorial sessions.

- Each theory credit corresponds to one contact hour per week, while each tutorial credit corresponds to two contact hours per week.
- The course shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.
- The CIE is evaluated for 50 marks through internal tests (30 marks) and other components (20 marks). Each internal test will have three questions and students shall answer any two full questions. Each question shall address all the Course Outcomes (COs) prescribed for that test. The average of the two tests shall be considered for awarding 30 marks. The remaining 20 marks shall be assessed through assignments, tutorial tests, quizzes, surprise tests, mini-projects, or other components as decided by the course instructor.
- The SEE examination shall consist of ten questions with internal choice (two questions per unit). Students shall answer any five full questions, selecting at least one question from each unit.

AEC is a 1-credit course involving 1 contact hour per week. The course shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.

- The CIE will comprise of two tests of 30 marks each having Part-A with MCQs for 6 marks and Part-B with Descriptive questions. The remaining 20 marks shall be assessed through assignments, surprise tests, quizzes, or other components as decided by the course instructor.
- The SEE will comprise of Part-A with MCQs (10 marks) and Part-B (5x8=40 marks) with descriptive questions.

PCC Laboratory is a 1-credit lab course involving 2 hours of lab sessions per week and uses both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) for assessment.

- CIE totals 50 marks, with 30 marks for lab sessions (Each laboratory experiment shall be evaluated for 10 marks based on the experiment record, conduction of the experiment, and observations, and the cumulative marks shall be scaled down to 30 marks.). Another 15 marks from a lab test and 05 marks for viva.
- SEE totals 50 marks, comprising 40 marks for procedure write up, experiment conduction & results and 10 marks for viva voce.

*** Lateral Entry Students:**

The Non-Credit Mandatory Course, Additional Mathematics II: is prescribed for IV Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other IV semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured 'F' grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE. Incase student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. Additional Mathematics II shall have CIE component only and no SEE component. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

Lateral Entry Students:

The Non-Credit Mandatory Course, Inter/Intra Institutional Internship: All the students admitted under lateral entry category shall have to undergo a mandatory Internship of 02 weeks during the intervening vacation of III and IV semesters. Summer Internship shall include Inter / Intra Institutional activities. A Viva-voce examination shall be conducted during IV semester based on which a student will be declared pass or fail. The internship shall be considered as a head of passing for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete internship requirements during subsequent semesters.

Lateral Entry Students:

AICTE Activity Points Requirement for BE Programs: As per AICTE guidelines (refer Chapter 6 – *AICTE Activity Point Program, Model Internship Guidelines*), in addition to academic requirements, students must earn a specified number of **Activity Points** to be eligible for the award of the degree. The points to be earned is:

1. **Regular students** admitted to a 4-year degree program must earn **100 Activity Points**.
2. **Lateral entry students** (joining from the second year) must earn **75 Activity Points**.
3. **Students transferred** from other universities directly into the V semester must earn **50 Activity Points** from the date of entry into VTU.

These Activity Points are non-credit and will not be considered for the SGPA/CGPA or be used for vertical progression. However, earning Activity Points is mandatory for the award of the degree, and the points earned will be reflected on the eighth semester Grade Card. If a student completes all the semesters (eight or six) at the end of the program but fails to earn the required Activity Points, the VIII semester Grade Card will be withheld until the requirement is fulfilled. Also, the degree will be awarded only after the Grade Card has been released. The hours spent earning the activity points will not be counted for regular attendance requirements. Students can accumulate these points at any time during their program period, including weekends, holidays, and vacations, starting from the year of admission, provided they meet the minimum hours of engagement prescribed for each activity by AICTE.

III SEMESTER

STATISTICS, PROBABILITY DISTRIBUTIONS AND INTEGRAL TRANSFORMS	
Course Code: ME31	**Credits: 2:1:0**
Pre – requisites: Calculus	**Contact Hours: 30L+30T+30S**
Course Coordinator: Dr. DINESH.P. A. & Dr. SUSHMA S	

Course Content

Unit I

Correlation and Regression: Curve fitting, Method of least squares - Linear, Quadratic and Geometric curves. Correlation and Regression-Linear, multivariate regression.

- Pedagogy/Course delivery tools:
  - Chalk and talk
- Links:
  - https://nptel.ac.in/courses/111107119
- Impartus recording:
  - https://a.impartus.com/ilc/#/course/3111313/1447

Unit II

Laplace Transform: Definition and existence condition, Laplace transform of elementary functions, properties of the Laplace transform.

Applications of Laplace Transform: Unit–step and unit–impulse function, inverse Laplace transform, solution of linear differential equations using Laplace transform, Engineering applications -Mechanical oscillator and Electrical circuits.

- Pedagogy/Course delivery tools
  - Chalk and talk
- Links
  - https://nptel.ac.in/courses/111105134
  - https://nptel.ac.in/courses/111105035
- Impartus recording:
  - https://a.impartus.com/ilc/#/course/59742/295

Unit III

Fourier Series: Introduction to series, Periodic functions, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period, Half range Fourier Cosine and Sine series, Practical harmonic analysis.

- Pedagogy/Course delivery tools:
  - Chalk and talk
- Links:
  - https://nptel.ac.in/courses/111107119
- Impartus recording:
  - https://a.impartus.com/ilc/#/course/619570/1030
  - https://a.impartus.com/ilc/#/course/107622/533
  - https://a.impartus.com/ilc/#/course/2975585/1331

Unit IV

Fourier Transform: Infinite Fourier transform and properties, Fourier sine and cosine transform, Inverse transforms, Convolution theorem and its significance, Parseval's identities.

- Pedagogy/Course delivery tools:
  - Chalk and talk
- Links:
  - https://nptel.ac.in/courses/111107119
- Impartus recording:
  - https://a.impartus.com/ilc/#/course/119635/593

Unit V

Random variable: Discrete and continuous random variables, probability density function,
Discrete Probability distributions: Binomial distribution and Poisson distribution.
Continuous Probability Distributions: Uniform distribution, Exponential distribution, Normal distribution.

- Pedagogy/Course delivery tools:
  - Chalk and talk, PowerPoint Presentation, Videos
- Links:
  - https://nptel.ac.in/courses/111107119

- Impartus recording:
  - https://a.impartus.com/ilc/#/course/96127/452
  - https://a.impartus.com/ilc/#/course/96151/1112

Text Books:

1. **Erwin Kreyszig** –Advanced Engineering Mathematics, Wiley publication, 10th edition, 2015
2. **Murray R Spiegel,John Schiller & R.Alu Srinivasan**- Probability and Statiistcs- Schaum's outlines-4th edition-2012
3. **Michel Greenberg-**Advanced Engineering Mathematics, Pearson Publishers, 2nd edition, 2013.

Reference Books:

1. **Srimanta Pal & Subobh C Bhunia -** Engineering Mathematics, Oxford University Press, 3rd Reprint, 2016.
2. **B.S.Grewal**-Higher Engineering Mathematics, Khanna Publishers, 44th edition,2017
3. **Glyn James & Phil Dyke** – Advanced Modern Engineering Mathematics, Pearson Education, 5th edition, 2018.

Course Outcomes

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

1. Fit a least squares curve to a given data and solve **multivariate regression models** involving more than one independent variables.**(PO–1,2 & PSO–1)**
2. Apply the Laplace Transform and its properties, to evaluate integrals and solve engineering and mathematical problems.**(PO–1,2 & PSO–1)**
3. construct the Fourier series expansion of functions/tabulated data.**(PO–1,2 & PSO–1)**
4. Evaluate Fourier transforms of given functions.**(PO–1,2 & PSO–1)**
5. Fit a suitable discrete and continuous probability distribution function and analyse for the given data .**(PO–1,2 & PSO–1)**

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test – I	30	CO1,CO2,CO3
Internal test – II	30	CO3,CO4,CO5
Average of the two internal tests will be taken for 30 marks.		
Other components	**Marks**	**Course outcomes addressed**
Quiz	10	CO1,CO2,CO3
Assignment	10	CO3,CO4,CO5
Semester End Examination (SEE)	100	CO1,CO2,CO3,CO4,CO5

MANUFACTURING PROCESS - I	
Course Code: ME32	**Credits: 3:0:1**
Pre – requisites: Nil	**Contact Hours: 45L+30P+45S**
Course Coordinator: Dr. D K VISHWAS	

Course Content

Unit I

Introduction to Casting - Casting, Steps involved in casting, Advantages and limitations of casting.
Pattern Making - Types of pattern, allowance.
Moulding Sand - Ingredients of molding sands and its properties. Core sand ingredients. Core Making.
Gating System – Definition, elements of gating system, functions and gating ratio
Molding Methods - Green molding, hand and machine molding. Jolt-Squeeze Machine and Sand slingers. Shell Molding and investment casting.
Melting Furnaces - Classification of Furnaces, Oil fired furnaces, Electric furnaces Arc, resistance and Induction furnaces.
Cleaning and Inspection of Castings - fettling operations, Defects in Casting.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: Casting Process-https://www.youtube.com/watch?v=2CIcvB72dmk
- Links: Furnaces for casting-https://www.youtube.com/watch?v=GUctNyh1FR0
- Lab component/ Practical topics: Preparation of Mould cavity using single piece and split piece pattern, Clay Content Test and moisture content test,

Unit II

Introduction to forming - Forming, classification, Advantages, limitations and applications.
Forging - Classification of forging processes, forging machines & equipment, Die-design parameters, Material flow lines in forging, forging defects.
Drawing - Steps involved in wire drawing, drawing die details, Types of tube drawing processes.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: Forging https://www.youtube.com/watch?v=r5FXtKoThj4
- Links: Drawing https://www.youtube.com/watch?v=rL9iEgeNCro
- Lab component/ Practical topics: Forging of a mild steel component into different shapes

Unit III

Extrusion - Types of extrusion processes, Special type of extrusion processes, Metal flow pattern in extrusion, Defects in extruded products.
Rolling - Classification. Types of rolling mills, Metal flow pattern in rolling, Defects in rolled products.
Sheet metal forming - Introduction, Material used, Operations, Punches and Dies used.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation
- Links: Extrusion https://www.youtube.com/watch?v=wuVnnfEocks
- Links: Rolling https://www.youtube.com/watch?v=MLRpwAEuVjI
- Links: Sheet Metal Work https://www.youtube.com/watch?v=LTZ4K3NoIr0

- Lab component/Practical topics: Permeability Test, Sand Hardness test, Sheet metal forming demo

Unit IV

Welding - Introduction, classification. Principles, TIG, MIG, SAW, FCAW, Electro slag welding. **Other Welding Processes** - Principle and applications of resistance welding (Spot), Thermit Welding, Friction welding, Explosive Welding, Ultrasonic welding, Laser Welding Processes.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation
- Links: Welding https://www.youtube.com/watch?v=jQddm3YONNc
- Links: Special Welding Processes https://www.youtube.com/watch?v=TlhGTSDfQxc
- Lab component/ Practical topics: Electric Arc Welding Demo, Sieve analysis

Unit V

Introduction to NDT - Nondestructive Testing, X –Ray radiography, dye penetrant test, Ultrasonic test, Magnetic particle Inspection, Eddy Current testing, Holography methods of Inspection.
NDT Techniques- Penetrant test, Magnetic particle Inspection, Ultrasonic test, Eddy Currenttesting, Holography methods of Inspection, X –Ray radiography.

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation
- Links: Destructive Testing- https://www.youtube.com/playlist?list=PL7Le4pic01uIA- 3SFGhMsrB3_wBG-8eru
- Links: NDT-https://www.youtube.com/watch?v=0VwKaHNvxLk
- Lab component/Practical topics:-Sand Test Using UTM

Text Books:

1. Manufacturing Technology: Foundry Forming and Welding, P.N. Rao 2 Edition TMH,2003
2. Manufacturing Technology", Serope Kalpakjain, Steuen.R.Sechmid, Pearson Education Asia, 5th Ed. 2006..
3. Mechanical metallurgy by George E. Dieter Tata McGraw - Hill publication. 3rd edition 2013.
4. Manufacturing Processes for Engineering materials by Serope kalpakajiam and
5. Steven R Schimid, Pearson education, 4th edition 2007.
6. Manufacturing Process-III, By Dr.Radha Krishna, Sudha Publications.2010. 2nd.

Reference Books:

1. Materials and Process of Manufacture, Roy A Lindberg, PHI Publications, 2 edition 2006.
2. Principal of Metal Casting, Heine, Loper, Philip Rosenthal, TMH. 1 21st edition2005.
3. Materials & Processes in Manufacturing by Paul Degarmo E, Jt Black, Ronald A Kohser. Prentice -hall of India, 8th edition 2006
4. Manufacturing Science, by Asok Kumar Mallik & Amitabha Ghosh – Affiliated East-west Press Pvt Ltd, 2nd edition 2012.
5. Fundamentals of Metal forming processes, B.L. Juneja, First edition New age International, 2007.
6. Theory of Plasticity and Metal forming Processes, Dr. Ssadhu singh, Khanna Publishers, 3rd

edition 2003

7. Metal Forming processes, by G.R Nagpal, Khanna Publishers, Second edition, 2005.

Web links and video lectures (e-Resources):

1. https://nptel.ac.in/courses/112107083
2. https://nptel.ac.in/courses/112107250
3. https://nptel.ac.in/courses/112107089
4. https://www.youtube.com/watch?v=DK1dItnI8mM

Course Outcomes (COs):

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

1. List and define the manufacturing processes such as casting, forming, joining processes. (PO1, 3, 5, 10, 11) (PSO1, 2)
2. Classify and compare different manufacturing processes. (PO1,3,5, 10, 11) (PSO1, 2)
3. Select suitable manufacturing processes for said applications (PO1,3,5,10, 11) (PSO1, 2)
4. Illustrate with sketches and arrive at the working principle of said manufacturing processes and inspection methods employed. (PO1, 3, 5, 10, 11) (PSO1, 2)
5. Justify the importance of examining a manufactured product before being put into service. (PO1, 3, 5,10, 11) (PSO1, 2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1, CO2, CO3, CO4 & CO5
Internal test-II	30	CO1, CO2, CO3, CO4 & CO5
Average of the two internal tests will be considered for the evaluation of 30 Marks		
Other components- 20 Marks		
Conduction of experiments/ Record writing	15	CO1,CO2,CO3 CO4,CO5
Laboratory test ,Viva-voce	05	CO1,CO2,CO3 CO4,CO5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO1,CO2, CO3, CO4 & CO5

BASIC THERMODYNAMICS	
Course Code: ME33	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 45L+45S**
Course Coordinator: Dr. ASHOK KUMAR K	

Course Content

Unit I

Fundamental concepts and definitions: Thermodynamics; definition and scope, microscopic and macroscopic approaches, types of system, thermodynamic properties, thermodynamic state, path and process, path and point function, quasistatic process, cyclic and non-cyclic processes, thermodynamic equilibrium, Zeroth law of thermodynamics,

Work and heat, Thermodynamic definition of work, expressions for displacement work in various processes through p v diagrams, heat definition, unit and sign convention, equivalence of heat and work

- Pedagogy/Course delivery tools: -Chalk and talk, animated videos
- Links: Thermodynamic properties-https://www.youtube.com/watch?v=iUEjQQtrT50
- Lab component/ Practical topics: -ATD lab

Unit II

First Law of Thermodynamics: Statement of first law of thermodynamics, extension of first law to non cyclic processes, energy, energy as a property of the system, enthalpy, specific heat at constant volume and constant pressure, Steady state, steady flow energy equation, some important applications

Second Law of thermodynamics: Thermal reservoir, Heat engine, schematic representation and efficiency, reversed heat engine, schematic representation and coefficient of performance, Kelvin-Planck statement and Clasius' statement of second law of thermodynamics, PMMI and PMMII, equivalence of the two statements

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: First law of TD -https://www.youtube.com/watch?v=ZvuhbYlMU_U
- Links: Kelvin plank and Clasius statements https://www.youtube.com/watch?v=L30WZ4PXp_c
- Lab component/ Practical topics:-ATD lab

Unit III

Carnot cycle : Reversible and irreversible processes, factors that make a process irreversible, reversible heat engine, carnot cycle, carnot principle

Entropy: Clasius inequality; statement, proof, application to a reversible cycle, entropy a property, entropy definition, principle of increase of entropy, calculation of entropy using T- dS relations, entropy as a coordinate.

- Pedagogy/ Course delivery tools:-Chalk and talk, animated videos
- Links: Carnot cycles-https://www.youtube.com/watch?v=7W-eX3yx1gM
- Links: Entropy -https://www.youtube.com/watch?v=umV67dqWVKw

Unit IV

Pure substance: P-T and P-V diagrams, triple point and critical points, subcooled liquid, saturated liquid, a mixture of saturated liquid and vapour, saturated vapour and superheated vapour states of a pure substance with water as an example. Enthalpy of change of phase (Latent heat), dryness fraction, T-S and h-s diagrams, representation of various processes on these diagrams, Steam tables and its use. **Combustion thermodynamics:**theoretical air for combustion of fuels,excess air,mass balance,actual combustion. Exhaust gas analysis, A/F ratio, energy balance for chemical reaction,enthalpy of formation, enthalpy and internal combustion energy, and combustion efficiency. Numerical problems.

- Pedagogy/ Course delivery tools and talk, PowerPoint presentation, animated videos
- Links: Pure substance-https://www.youtube.com/watch?v=OHhnm2p5G3o
- Links: Combustion thermodynamics-https://www.youtube.com/watch?v=uvR7zNJ1KoI
- Lab component/ Practical topics:-ATD lab

Unit V

Ideal and Real gases: Introduction, Vander Wall's equation, Vander Wall's constants in terms of critical properties, law of corresponding states, compressibility factor, compressibility chart, ideal gas, equation of state, internal energy and enthalpy as functions of temperature only, universal and particular gas constants, ideal gas mixture; Dalton's law of additive pressure, Amagat's law of additive volumes, evaluation of properties, analysis of various processes.

- Pedagogy/ Course delivery tools:-Chalk and talk, Powerpoint presentation, animated videos
- Links: Ideal gases-https://www.youtube.com/watch?v=1yymkQQOPAo
- Links: Real gases-https://www.youtube.com/watch?v=sTufBlv9e20
- Lab component/Practical topics:-Heat transfer lab- Air conditioning test rig

Text Books:

1. Fundamental of Classical Thermodynamics- G J Van Wylen and R E Sonntag, Wiley Eastern. 1st edition, 2002
2. Basic and Applied Thermodynamics- P K Nag, Tata McGraw-Hill, 3rd edition., 2002

Reference Books:

1. Thermodynamics is an engineering approach. Yunus A. Cenegal and Michael A. Boles. Tata McGraw hill Pub. 1st edition 2002
2. Engineering Thermodynamics- R K Rajput, Laxmi publications Pvt Ltd, 3rd Edition.,2007

Web links and video lectures (e-Resources):

1. https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8
2. https://www.youtube.com/watch?v=fdW7HmgEPgA
3. https://www.youtube.com/watch?v=3btbPs5wvNw
4. https://www.youtube.com/watch?v=G-L81TfsqKI
5. https://www.youtube.com/watch?v=WomsUEVVtCk

Course Outcomes (COs):

Students will be able to

1. Understand the principles of thermodynamics in engineering applications and analyze energy interactions in terms of work and heat (PO1, PO2, PO3, PSO1)
2. Solve problems associated with various thermodynamic processes and calculate the properties of a thermodynamic system during the execution of a process or cycle (PO1, PO2, PO4, PSO1)
3. Apply the principle of entropy to calculate entropy during the execution of a process or cycle, and demonstrate the concept of the Carnot cycle (PO1, PO2, PO4, PSO1)
4. Interpret thermodynamic behaviour of pure substances using P-v, T-s, and h-s diagrams; apply steam tables to analyse phase-change processes. (PO1, PO2, PO4, PSO1)
5. Evaluate the behavior of ideal and real gases, apply gas laws to engineering processes, and analyze thermodynamic systems involving gas mixtures and their properties. (PO1, PO2, PO4, PSO1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1 &CO2
Internal test-II	30	CO3, CO4 & CO5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment/Quiz	10	CO1,CO2,CO3 CO4,CO5
Mini Project/seminar/Surprise test	10	CO1,CO2,CO3 CO4,CO5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO1,CO2, CO3, CO4 & CO5

MECHANICS OF MATERIALS	
Course Code: ME34	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 45L+45S**
Course Coordinator: Dr. ARUNA KUMAR P C	

Course Content

Unit I

Simple stress and strain: Introduction, stress, strain, mechanical properties of materials, linear elasticity, Hook's law and poisons ratio, stress-strain relation – behaviour in tension for mild steel and non-ferrous metals. Extension/shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular) Elongation due to self-weight, principle of superposition,

Volumetric strain: expression for volumetric strain, Stress in composite section, Elastic constants, simple shear stress, shear strain.

Temperature stresses (including compound bars)

- Pedagogy/Course delivery tools:-Chalk and talk, animated videos
- Links: Simple stress and strain-https://www.youtube.com/watch?v=B9lyGZzb_6M
- Links: volumetric strain-https://www.youtube.com/watch?v=w8IZOi0n3Mk
- Links: temperature stresses-https://www.youtube.com/watch?v=dzeCpS7xTno
- Lab component/Practical topics:-Tensile and compression tests

Unit II

Compound stresses: Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress.

Thick and thin cylinders: stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume) , Thick cylinders subjected to internal and external pressures (Lame's equation) (Compound cylinders not included)

- Pedagogy/Course delivery tools:-Chalk and talk, animated videos
- Links: compound stresses-https://www.youtube.com/watch?v=bY9PW66AUQQ
- Links: Thick and thin cylinders-https://www.youtube.com/watch?v=y2dbpuBYPjU
- Lab component/Practical topics:-Tensile, compression tests

Unit III

Bending moment and shear force in beams: Introduction, rate of loading, sign conventions, relationship between shear force and bending moments, shear force and bending moment diagrams for different beams subjected to concentrated loads, uniform distributed load (UDL)and couple for different types of beams.

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: SFD & BMD-https://www.youtube.com/watch?v=pMUG_2CoP4I
- Links: SFD & BMD-https://www.youtube.com/watch?v=arr_xwk-JsM
- Lab component/ Practical topics:-Bending test

Unit IV

Bending stresses in beams: Introduction, theory of simple bending. Assumptions in simple bending, relationship between bending stresses and radius of curvature, relationship between bending moment and radius of curvature, moment carrying capacity of a section.

Shear stresses in beams: Shear stress across rectangular, I Section , T section & circular sections.

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: Bending stresses-https://www.youtube.com/watch?v=EDN9yFr4ehY
- Links: shear stresses-https://www.youtube.com/watch?v=PZJxokhWL3E
- Lab component/ Practical topics:-Bending and shear tests

Unit V

Deflection of beams: Introduction, differential equation for deflection, equations for deflections, slope and moments, double integration method for cantilever and supported beams for point load, UDL. Macaulay's Method.

Torsion of circular shafts: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity/stiffness of shafts, power transmitted by solid and hollow circular shafts.

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: Deflection of beams-https://www.youtube.com/watch?v=Qt-lls7jV5I
- Links: torsion of circular shafts- https://www.youtube.com/watch?v=OBTZAYqHSY8
- Lab component/Practical topics:-Torsion test

Text Books:

1. Mechanics of materials, S.I units, Ferdinand Beer & Russell Johnston, TATA McGraw-Hill – 1st edition 2003
2. Strength of materials, W.A Nash, Schaums outline series, 4th edition – 2007

Reference Books:

1. Mechanics of materials, K.V. Rao, G.C. Raju, 1st edition, 2007
2. Strength of materials, Ramamrutham, 5th edition 2006.
3. Mechanics of materials, James. M Gere. Thomson, 5th edition, 2004

Web links and video lectures (e-Resources):

1. https://www.youtube.com/watch?v=DzyIEz3dKXQ
2. https://www.youtube.com/watch?v=2PM4mT3nKwk
3. https://www.youtube.com/watch?v=--d22GM6wMQ
4. https://www.youtube.com/watch?v=sP34uzn7diA
5. https://www.youtube.com/watch?v=r0YA2Nr6bxQ

Course Outcomes (COs):

1. Develop an understanding of behavior of components when subjected to various type of loading. (PO: 1,2,3) (PSO: 1,2)
2. Compile fundamentals of MOM for engineering applications. (PO: 1,2) (PSO: 1,2)
3. Develop ability to identify a problem and apply the fundamental concepts of MOM. (PO: 1,2,3) (PSO: 1,2)
4. Develop competence to design and analyze problems of engineering involving design of components subjected to stresses and strains. (PO: 1,2,3,4,5) (PSO: 1,2)
5. Demonstrate ability to have the competence for undergoing knowledge up gradation in the Advanced subjects of Machine Design, FEM, Theory of Elasticity and Vibrations. (PO: 1,2,3,4,5) (PSO: 1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1,CO2&CO3
Internal test-II	30	CO3, CO4 & CO5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO1,CO2,CO3 CO4,CO5
Surprise test	10	CO1,CO2,CO3 CO4,CO5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO1,CO2, CO3, CO4 & CO5

MATERIAL SCIENCE & METALLURGY	
Course Code: ME35	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 45L+45S**
Course Coordinator: Dr. RAJENDRA P	

Course Content

Unit I

Structure of Crystalline solids: Fundamental concepts of Unit cell, space lattice, Bravais space lattices, Coordination Number and Atomic Packing Factor for different cubic and HCP structures. Crystal imperfections: Classification, point, line, surface & volume defects.

Diffusion: Diffusion mechanisms, and factors affecting diffusion, Fick's laws of diffusion, Stress vs. Strain diagrams to show ductile & brittle behavior of metals.

- Pedagogy/Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: Unit Cells - Number of Atoms in a Unit Cell-https://www.youtube.com/watch?v=qAeaHYSX0hs
- Links: Crystal imperfections-https://www.youtube.com/watch?v=HuMQqSj8zdo

Unit II

Mechanical Behavior of Materials: Linear & non-linear elastic properties, Concept of true stress and true strain. Plastic deformation of metals by Slip and Twinning, strain hardening and strengthening mechanisms in crystalline materials.

Fatigue: Definition of Fatigue, types of fatigue loading, mechanism of fatigue failure, fatigue properties, S-N diagram, factors affecting fatigue strength.

- Pedagogy/Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: Plastic deformation of metals by Slip and Twinning-https://www.youtube.com/watch?v=LifL-DNdtpU
- Links: Fatigue cycles-https://www.youtube.com/watch?v=OlexdbPETPw

Unit III

Fracture and Creep: Fracture, types, transition from ductile to brittle fracture. Creep - Definition, three stages of creep, creep properties, Creep mechanisms

Solidification, **Solid solutions & Phase diagrams:** Nucleation, homogeneous & heterogeneous nucleation, crystal growth, cast metal structures. Solid solutions: Types, Rules governing the formation of solids solutions.

- Pedagogy/Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: Creep-https://www.youtube.com/watch?v=zH05sDLKMoU
- Links: Nucleation-https://www.youtube.com/watch?v=Od5yT-l7aK4

Unit IV

Phase diagrams: Basic terms, phase rule, Lever rule, cooling curves, construction of phase diagrams, Types of phase diagrams, interpretation of equilibrium diagrams: eutectic, eutectoid, peritectic & peritectoid, problems in phase diagrams.

Iron carbon equilibrium diagram& TTT diagram: Equilibrium phases in the Fe-C system, Microstructure of slowly cooled steels, TTT diagram, construction of TTT diagram, Superimposing cooling curves on TTT diagram & non-equilibrium phases in Fe-C system,

- Pedagogy/Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: Phase Diagrams-https://www.youtube.com/watch?v=7hmF3WoQkTg
- Links: Iron-carbon equilibrium diagram-https://www.youtube.com/watch?v=Izhv87GIL4U

Unit V

Heat Treatment: Annealing and its types, Normalizing, Hardening, Tempering, Martempering, Austempering, Surface hardening like case hardening, carburizing, cyaniding, nitriding, Induction hardening, Age hardening taking the example of duralumin.

Alloys and composites: Ferrous alloys and its classification, Important Aluminum, Magnesium, Titanium and Copper alloys. Composites materials and its classification, advantages, and applications of composites.

- Pedagogy/Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: Heat Treatment types-https://www.youtube.com/watch?v=8H3TiU-Uks8
- Links: Composite Materials-https://www.youtube.com/watch?v=wrnuljdwpjo

Text Books:

1. Introduction to Material Science for Engineering, 6th edition, James F.Shackel Ford, Pearson, Prentice Hall, New Jersey, 2006.
2. Physical Metallurgy, Principles & Practices, V.Raghavan, PHI, 2nd edition, 2006,New Delhi.

Reference Books:

1. Materials Science & Engineering- An Introduction, William D. Callister Jr., Wiley, India Pvt. Ltd., 6th edition, 2006, New Delhi.
2. Essentials of Materials for Science And Engineering, Donald R. Askeland, Pradeep P.Phule Thomson-Engineering, 2nd edition 2006
3. Foundation of Material Science and Engineering, Smith, 3rdEdition, McGraw ill,1997 edition.

Course Outcomes (COs):

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

1. **Discuss** the concept of crystal structure, crystal imperfections and Mechanical properties in metals (PO1, PO11, PO2, PSO1, PSO2)
2. **Explain** the concept of true stress and true strain, plastic deformation and various modes of failure. (PO1, PO2, PO3, PO4, PO11 & PSO1, PSO2)
3. **Summarize** the solidification of metals and alloys and classify draw phase diagrams (PO1, PO2, PO3, PO4, PO5, PO11, PSO1, PSO2)
4. **Distinguish** between various heat treatment processes for metals and alloys (PO1, PO2, PO3, PO4, PO5, PO11, PSO1, PSO2)
5. **Examine** composite manufacturing processes and list advantages and applications of engineering and composite materials (PO1, PO4, PO5, PO6, PO11, PSO1, PSO2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1 &CO2
Internal test-II	30	CO3, CO4 & CO5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment/Quiz/Mini Project	10	CO1,CO2,CO3 CO4,CO5
Seminar/Presentation/Group activity/Case study/Surprise test	10	CO1,CO2,CO3 CO4,CO5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO1, CO2, CO3, CO4 & CO5

UNIVERSAL HUMAN VALUES	
Course Code: UHV36	**Credits: 2:0:0**
Pre – requisites: Nil	**Contact Hours: 30L**
Course Coordinator: Dr. N L RAMESH	

Course Content

Unit I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self-Exploration–what is it? – it's content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario.
6. .Method to fulfill the above human aspirations: understanding and living in harmony at variouslevels.

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation, Videos.
- Links: Holistic Development and Role of Education: https://youtu.be/sGZtTPe-lhQ
- Lab component / Practical Topics: Survey/polls for self-exploration

Unit II

Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human beings as a co-existence of the sentient 'I' and the material 'Body'.
2. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha.
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of 'I' and harmony in 'I'.
5. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, the meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Swasthya - Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation, Videos.
- Links: Harmony in Human Being- Self and Body: https://youtu.be/0ERSMkRPQBM
- Links: Harmony in Human Being- Self: https://youtu.be/83oGJ4oDeIg
- Links: Harmony between Self and Body Prosperity: https://youtu.be/aJ_BU2OgpKs
- Lab component / Practical Topics: Survey and polls for self-exploration

Unit III

Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

1. Understanding Harmony in the family – the basic unit of human interaction.
2. Understanding values in a human-human relationship; the meaning of Nyaya and the program

for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship.

3. Understanding the meaning of Vishwas; Difference between intention and competence.
4. Understanding the meaning of Samman, the Difference between respect and differentiation; the other salient values in the relationship.
5. Understanding the harmony in the society (society being an extension of the family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals.
6. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family!
7. Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: Harmony in Family- Trust: https://youtu.be/F2KVW4WNnS8
- Links: Harmony in family- Respect: https://youtu.be/iLqNRPuv0_8
- Links: Harmony in family- Other Feeling Justice: https://youtu.be/TcYJB7reKnM
- Links: Harmony in the Society: https://youtu.be/BkWgFinrnPw1
- Lab component / Practical Topics: Survey and polls for self-exploration

Unit IV

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

1. Understanding the harmony in the Nature.
2. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space.
4. Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation, Videos.
- Links: Harmony in Nature: https://youtu.be/K1Jpd_ojydw
- Links: Harmony in Existence: https://youtu.be/mormUeZ_RUE
- Lab component / Practical Topics: Survey and polls for self-exploration

Unit V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values.
2. Definitiveness of Ethical Human Conduct.
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
4. Competence in professional ethics:
    1) Ability to utilize the professional competence for augmenting universal human order
    2) Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems,
    3) Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems.
6. Strategy for transition from the present state to Universal Human Order:
    1) At the level of individual: as socially and ecologically responsible engineers,

technologists and managers.

2) At the level of society: as mutually enriching institutions and organizations.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey and polls for self-exploration

Text Books:

1. R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and Professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

Reference Books:

1. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.
6. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
8. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, Human Values, New Age International Publishers.

Course Outcomes (COs):

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

1. Apprehend the need of Value Education over Human aspirations. [PO6]
2. Assimilate Harmony over the physical needs and to overcome the self- needs for a prosperous life. [PO6]
3. Recognize the need of Harmony in the Family and Society for a better World. [PO6]
4. Explain the need of mutual understanding for Holistic Harmony in all the Levels of Human Existence. [PO6]
5. Explain the Holistic understanding of Harmony and Professional Ethics at Individual Level and Society. [PO6, PO7]

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
2. https://www.youtube.com/watch?v=P4vjfE-YnVk&list=PLWDeKF97v9SP7wSlapZcQRrT7OH0ZlGC4
   Course handouts: https://drive.google.com/drive/folders/1zioX_4L2fCNX4Agw282PN86pcZZT3Osr?usp=sharing

Course Assessment and Evaluation

Continuous Internal Evaluation- 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO3, CO4 & CO5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment/Quiz	10	CO1,CO2,CO3 CO4,CO5
Mini Project/seminar/Presentation/Group activity	10	CO1,CO2,CO3 CO4,CO5
Semester End Examination- 100 Marks		
Semester End Examination	50	CO1,CO2, CO3, CO4 & CO5

INDIAN EDUCATION SYSTEM	
Course Code: MEAEC37	**Credits: 1:0:0**
Pre – requisites: NIL	**Contact Hours: 15L**
Course Coordinator: Dr. B.P. HARICHANDRA & Dr. K. LOKESHA	

Unit I

Introduction

Education, literacy, Jnana and vidya, knowledge systems, Process of learning: Shravana, manana and nididyasana. Indigenous centers of learning: Types of teachers, places and types of learning centers. Shastrarta, samvaada, samarpane, kshetrakarya and seva modes of learning. Samavartana.

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentations
- Video link: https://youtu.be/kvTAT4B0SBo

Video link: https://www.youtube.com/watch?v=FK__F0KdOQ4

Unit II

Gurukula system of education

Aims of education in gurukulas, wholesome development of individual. Typical Gurukulas of the past. Principles and practice of curriculum in a gurukula. Typical benchmark practices

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentations • Video link: https://youtu.be/kvTAT4B0SBo

Unit III

Historical Reports

Reports of Andrew Bell and William Adams; messages for modern education

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentations, Videos
- Online reading material: https://archive.org/details/beautifultreeper00tool

Unit IV

Present blended and traditional gurukulas

Pedagogical and academical attributes of typical current blended and traditional gurukulas. Methods to inculcate their advantages into modern systems for students and institutions.

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentations • Video link: https://youtu.be/2H4yyJjtG88

Unit V

National Education Policy 2020

Fundamental principles of NEP2020. Advantages and challenges of NEP2020 for students and institutions

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentations
- Video intro: https://www.youtube.com/watch?v=glEs826y8X0 Video: https://www.youtube.com/watch?v=cWsxSP3KGvs

Text Books:

1. **The Beautiful Tree –** Dharampal, Other India Press, Goa
2. **Government of India –** New education Policy 2020, https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf

Course Outcomes (COs):

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

1. Understand the fundamental components of education and strategies of learning in the indigenous mode.(P06,P07,PS01)
2. To understand the gurukula system of education .(P06,P07,PS01)
3. To understand the importance of wholesome education as envisaged in the past and applicable for the present too.(P06,P07,PS01)
4. To learn how to adopt the benchmarks of the traditional systems into modern ones.(P06,P07,PS01)
5. To understand the latest policies in the field of Education in India to enhance their abilities(P06,P07,PS01)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2 & CO3
Internal Test-II	30	CO4 & CO5
Average of the two internal test shall be taken for 30 marks		
Other components		
Assignment/Quiz	10	CO1,CO2,CO3 CO4,CO5
MiniProject/seminar/Presentation/Group activity	10	CO1,CO2,CO3 CO4,CO5
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4 & CO5

MATERIALS TESTING LABORATORY	
Course Code: MEL38	**Credits: 0:0:1**
Pre – requisites: Nil	**Contact Hours: 30P**
Course Coordinator: Dr. GIRISH V KULKARNI	

Course Content

PART - A

List of experiments

1. Rockwell Hardness Test
2. Brinell Hardness Test
3. Vickers Hardness Test (Demo)
4. Charpy Impact Test
5. Izod impact test
6. Study of Metallurgical Microscope – Calibration of eyepiece reticle
7. Microstructure Examination

PART - B

List of experiments

1. Tensile Test
2. Compression Test
3. Shear Test
4. Bending Test
5. Torsion Test
6. Wear Test
7. Drop Weight
8. Impact Test
9. (Demo), Wear response of material using Linear Reciprocating Tribometer

Reference Books:

1. Mechanics of Materials James M. Gere, Barry J. Goodno Publication CL Engineering; 8 edition, 2012.
2. Materials Science & Engineering- An Introduction, William D. Callister Jr. Publication Wiley, 9 edition, 2013
3. Materials testing laboratory manual, Department of Mechanical Engineering, MSRIT Web Links and Video Lectures:

1. https://sm-nitk.vlabs.ac.in/exp/rockwell-hardness-test/videos.html
2. https://sm-nitk.vlabs.ac.in/exp/brinell-hardness-test/videos.html
3. https://sm-nitk.vlabs.ac.in/exp/vickers-hardness-test/videos.html
4. https://sm-nitk.vlabs.ac.in/exp/charpy-impact-test/videos.html
5. https://sm-nitk.vlabs.ac.in/exp/izod-impact-test/videos.html
6. https://sm-nitk.vlabs.ac.in/exp/tensile-test-mild-steel/videos.html
7. https://sm-nitk.vlabs.ac.in/exp/compression-test-mild-steel/videos.html
8. https://sm-nitk.vlabs.ac.in/exp/direct-shear-test-steel-rod/videos.html

9. https://sm-nitk.vlabs.ac.in/exp/torsion-test-mild-steel/videos.html

Course Outcomes (COs):

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

1. Demonstrate the knowledge and the skills required concerning the procedure for conducting and analyzing the results concerning Tensile, Shear and Compression, Torsion Test, Bending Test, etc. (PO1, PO2, PO5, PO8, PO9, PO10, PO11, PSO1, PSO2)
2. Knowledge of various heat treatment processes, hardness, and wear tests (PO1, PO2, PO5, PO8, PO9, PO10, PO11, PSO1, PSO2).
3. Microstructure examination and identification of metals. (PO1, PO2, PO5, PO8, PO9, PO10, PO11, PSO1, PSO2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tool	**Marks**	**Course Outcomes addressed**
Weekly evaluation of laboratory journals/ reports after the conduction of every experiment	30	CO1, CO2 & CO3
Laboratory Test	10	CO1, CO2 & CO3
Viva-Voce	10	
Semester End Examination (SEE):	50	CO1, CO2 & CO3

COMPUTER AIDED MACHINE DRAWING	
Course Code: MEL39	**Credits: 0:0:1**
Pre – requisites: NIL	**Contact Hours: 30P**
Course Coordinator:Mr. DEEPAK S	

Course Content

PART A

3D Modeling and Orthographic Views: Conversion of Pictorial Views into 3D Models and converting 3D Models into Orthographic view (simple hand) of simple machine parts with and without section, using modelling software. (ISO - Technical Drawings and Specifications) Hidden Lines. (3D CAD Software) **Sections of Solids:** Sections of pyramids, Prisms, cubes, Tetrahedron, cones and cylinders resting only on their bases. (No problems on axis inclinations, spheres and hollow solids). True shape of sections. Free hand sketch for solution and drafting using software (3D CAD Software)

- Pedagogy/Course delivery tools-Chalk and talk, Powerpoint presentation, Animated videos
- Lab Component / Practical Topics-Machine Components in Machine Shop
- Links-https://www.youtube.com/watch?v=3j2YEuTiAOc
- Links -https://www.youtube.com/watch?v=AzFz8A5HgiQ

PART B

Parametric Modeling: Parametric Modeling of Washer, Base Plate, Bracket and simple machine parts (Sketch Work – Show orthographic views only) with parametric equations. Input based on Excel Sheet. (3D CAD Software)

- Pedagogy/Course delivery tools-Chalk and talk, PowerPoint presentation, Animated videos
- Lab Component / Practical Topics-Creation of 3D CAD Models
- Creation of parametric models
- Links-https://www.youtube.com/watch?v=JvsJf1huMXQ
- Links -https://www.youtube.com/watch?v=SDFjnAsBqLU

PART C

Assembly Drawings –

1. Wheel Assembly
2. Screw Jack
3. Plummer Block.

- Pedagogy/Course delivery tools-Chalk and talk, PowerPoint presentation, Animated videos
- Lab Component / Practical Topics-Subassemblies in Machines at Machine Shop
- Links-https://www.youtube.com/watch?v=mSWGCpZW3xg
- https://www.youtube.com/watch?v=b6h_ZiGoLY0

Text Books:

1. Computer Aided Machine Drawing K.R. Gopalakrishna, Subhash Publications, 2nd edition 2012.
2. Computer Aided Machine Drawing, Tryambaka Murthy.

Reference Books:

1. SOLIDWORKS 2021 for Designers, 19th Edition Paperback – 8 February 2021, Publisher: CADCIM Technologies (8 February 2021), Language: English, Paperback: 1040 pages, ISBN-

10: 1640571035, ISBN-13: 978-1640571037

Course Outcomes (COs):

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

1. Acquire the skills needed to draw the orthographic and sectional views of the solid. (PO: 1,3,5,8,11) (PSO: 1,2)
2. Create 3D Models and Present sectional view, orthographic views and Isometric views of the part that can be read by a shop floor engineer. (PO: 1,3,5,8,11) (PSO: 1,2)
3. Create and assemble the 3-D part models using a CAD tool and draw the sectional view, orthographic views, and Isometric view of the assembly including the bill of materials, section plane, and ballooning. (PO: 1,3,5,8,11) PSO: 1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Assignment, Sketch Work and Printout	30	CO1, CO2 and CO3
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Laboratory test	20	CO1, CO2 and CO3
Semester End Examination (SEE): 50 Marks		
Semester End Examination	50	CO1, CO2, CO3

Exam Pattern - Answer any one out of two questions from PART A, PART B, and PART C.
Part A and B - 10 Marks; Part C – 30 Marks;
Answer two questions with 10 marks each
Answer to any one question 30 marks
Total - 50 Marks Duration of Exam: 3Hrs

IV SEMESTER

MACHINE DESIGN-I	
Course Code: ME41	**Credits: 3:0:1**
Pre – requisites: Nil	**Contact Hours: 45L+30P+45S**
Course Coordinator: Dr. Mahantesh S Matur	

Course Content

Unit I

Introduction: Design considerations: codes and standards, Static Strength, Static loads and Factor of safety. Impact loads, Impact stresses due to axial and bending.

Theories of failure: Maximum normal stress theory, Maximum shear stress theory, Distortion energy theory. Failure of brittle materials, Failure of ductile materials.

Stress concentration: Determination of Stress concentration factor for axial, bending, torsion.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: https://a.impartus.com/ilc/#/video/id/1620141
- Links: https://www.youtube.com/watch?v=-SA4D098u-Q
- Lab component/ Practical topics: Simulation & stress analysis of simple machine components using software

Unit II

Design for Fatigue Load: Introduction- S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit, Endurance limit modifying factors: size effect, surface effect, Stress concentration effects; Fluctuating stresses, Goodman and Soderberg relationship; stresses due to combined loading,

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos, Demonstration using IC engine models
- Links: Fatigue loading: https://a.impartus.com/ilc/#/course/130428/636
- Lab component/ Practical topics: Simulation & fatigue analysis of simple machine components using software

Unit III

Shafts: ASME & BIS codes for design of transmission shafting, shafts under fluctuating loads and combined loads.

Cotter and Knuckle joints: Design of Cotter and Knuckle joints.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Shafts-https://a.impartus.com/ilc/#/video/id/1654576
- Lab component/Practical topics: Design and Drawing of Cotter joint and Knuckle joint using 3D Modelling Software

Unit IV

Keys: Types of keys, Design of keys and design of splines. Couplings, Rigid and flexible couplings, Flange coupling, Bush and Pin type coupling.

Riveted Joints – Types, rivet materials, failures of riveted joints, Joint Efficiency, Boiler Joints,

Tank and Structural Joints, Riveted Brackets

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Design and drawing of different types of riveted joints
- Links: https://a.impartus.com/ilc/#/video/id/1568859
- Lab component/Practical topics: Design and Drawing of Couplings using 3D Modelling Software

Unit V

Welded Joints: Types, strength of butt and fillet welds, eccentrically loaded welded joints.
Power Screws: Mechanics of power screw, Stresses in power screws, efficiency and self-locking, Design of Power Screw**.**

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Design and drawing of screw jack (Bottle Type)
- Links: https://a.impartus.com/ilc/#/video/id/1603316
- Lab component/Practical topics: Design and Drawing of welded joints, 3D Modelling Software

Design Data Hand Books:

1. Design Data Hand Book vol.1 & 2 – K. Lingaiah, McGraw Hill, 2nd Ed. 2003.
2. Design Data Hand Book by K. Mahadevan and Balaveera Reddy, CBS Publication

Text Books:

1. Mechanical Engineering Design: Joseph E Shigley and Charles R. Mischke McGraw Hill International edition, 6th Edition 2003.
2. Design of Machine Elements: V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.

Reference Books:

1. Machine Design: Robert L. Norton, Pearson Education Asia, 2001.
2. Design of Machine Elements: M.F.Spotts, T.E. Shoup, L.E. Hornberger, S.R. Jayram and C.V. Venkatesh, Pearson Education, 2006.
3. Machine Design: Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.
4. Fundamentals of Machine Component Design: Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007.

Web links and video lectures (e-Resources):

1. https://youtu.be/ofmbhbVCUqI
2. https://youtu.be/m9l1tVXyFp8
3. https://youtu.be/jolY82CpmGo
4. https://www.digimat.in/nptel/courses/video/112105124/L10.html
5. https://a.impartus.com/ilc/#/video/id/1603316

Course Outcomes (COs):

1. Apply concepts of static loads, stress concentration and theories of failure in the design of machine components (PO 1,2, 3, 4) (PSO1, 2)
2. Understand concepts of Fatigue loads and design of machine element. (PO 1,2, 3, 4) PSO1, 2)
3. Develop the ability to understand the procedural design of shafts, cotter joints & knuckle joints (PO 1,2, 3, 4) (PSO1, 2)
4. Demonstrate the ability to analyze the problems of keys and riveted joints. (PO 1,2, 3, 4) (PSO1, 2)
5. Develop competence to design of welded joints and power screws. (PO1,2, 3, 4) (PSO1, 2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1 & CO2
Internal test-II	30	CO3, CO4 & CO5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Design &Simulation and Record writing	15	CO1,CO2,CO3 CO4,CO5
Laboratory test	05	CO1,CO2,CO3 CO4,CO5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO1, CO2, CO3, CO4 & CO5

APPLIED THERMODYNAMICS	
Course Code: ME42	**Credits: 3:0:0**
Pre – requisites: NIL	**Contact Hours: 45L+45S**
Course Coordinator: Dr. P.B. Nagaraj	

Course Content

Unit I

Combustion in SI and CI engines: Ignition limits, stages of combustion in SI engine, Effect of engine variables on Ignition lag, abnormal combustion, Detonation or knocking and its effect, stages of combustion in CI engines, Delay period in CI engines and variables affecting the delay period, diesel knock and methods of controlling the diesel knock, Testing and Performance of Single Cylinder and Multi cylinder Engines, measurement of performance parameters, heat balance sheet. Numerical problems

- Pedagogy/Course delivery tools: Chalk and talk, animated videos
- Links: Fundamentals of combustion: https://nptel.ac.in/courses/101104070
- Links: Performance of I C Engine: https://www.youtube.com/watch?v=2b0YaDrdO1I
- Lab component/Practical topics: ATD lab-2S & 4S test rigs.

Unit II

Gas power cycles: Air standard cycles, Otto, Diesel, Dual , p v and T s diagrams, description, efficiencies and mean effective pressures, comparison of otto, diesel and dual combustion cycles **Gas turbines and Jet propulsion:** Classification of gas turbines, analysis of open cycle gas turbine cycle, methods to improve thermal efficiency (no numerical on this topic),Reaction and impulse turbines, velocity triangles Jet propulsion and Rocket propulsion.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Gas turbines and I C engines: https://nptel.ac.in/courses/112103262
- Links: Introduction to Air breathing propulsion: https://onlinecourses.nptel.ac.in/noc20_ae13/preview
- Lab component/Practical topics: ATD lab-Computerized 4S Petrol & Diesel engine

Unit III

Steam Nozzles: Introduction, types of nozzles, steady flow energy equation in nozzles, entropy changes with friction, nozzle efficiency, mass discharge through nozzle, throat pressure for maximum discharge, critical pressure ratio for adiabatic and frictionless expansion from a given initial velocity, numerical problems

Vapour power cycles: Carnot vapour power cycle, drawbacks as a reference cycle, simple Rankine cycle; description, T-S diagram, analysis for performance, comparison of carnot and rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles, numerical problems

- Pedagogy/ Course delivery tools: Chalk and talk, animated videos
- Links: Introduction to Steam nozzles-https://www.youtube.com/watch?v=AXcb3TBLETY
- Links: Use of h-s diagram -https://www.youtube.com/watch?v=iZQlt1kp1dw

- Lab component/Practical topics: Turbo Machinery lab- Nozzles

Unit IV

Reciprocating Compressors: Operation of a single stage reciprocating compressors, work input through p-v diagram, effect of clearance and volumetric efficiency, adiabatic, isothermal and mechanical efficiencies. Multi-stage compressor, saving in work, optimum intermediate pressure, inter-cooling, minimum work for compression.

Refrigeration: Principle, methods of refrigeration, units of refrigeration, COP, Vapour compression refrigeration (VCR) system; description, analysis, refrigerating effect, capacity, power required, Thermodynamic analysis of VCR cycle, operating parameters affecting the COP of VCR cycle.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Air compressor: https://www.youtube.com/watch?v=VO0IVe9ZHY0& list=PL07gcSkcblxqX3itLTFpPAcX7B_SSRYSr
- Links: Refrigeration-https://www.youtube.com/watch?v=nlsNmhiID74& list=PLfUUbFVTz-XcXbSUD0BXdPxGXFGkcdLXa
- Lab component/Practical topics: ATD lab & Heat transfer lab-Air compressor test rig, Refrigeration tutor & Air conditioning test rig

Unit V

Psychrometrics: Atmospheric air and psychrometric properties: DBT, WBT, DPT, partial pressures, specific and relative humidity and relation between the two, enthalpy and adiabatic saturation temperatures, Construction and use of psychrometric chart. Analysis of various processes: Heating, cooling, dehumidifying and humidifying. Adiabatic mixing of stream of moist air. Summer and winterair conditioning.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Basic concepts of Psychrometric processes: https://www.youtube.com/watch?v=YoN5251ta18
- Links: Psychrometric chart: https://www.youtube.com/watch?v=e2IryaMQQ6A
- Lab component/Practical topics: Heat transfer lab- Air conditioning test rig

Text Books:

1. Basic and Applied thermodynamics by P K Nag, Tata McGraw Hill pub co., 2nd edition 2002
2. Thermodynamics- An Engineering Approach-Yunus, A Cenegal and Michael A Boles, Tata McGraw Hill Publications.,1st edition 2002

Reference Books:

1. Internal combustion engines- M L Mathur and R P Sharma, Dhanpat Rai Publications.,3rd edition 2007
2. Thermal Engineering- R K Rajput, Laxmi Publications,3rd edition 2003

Web links and video lectures (e-Resources):

1. https://www.youtube.com/watch?v=cQnj8DOc9B8
2. https://www.youtube.com/watch?v=30-FdRgygI0
3. https://www.youtube.com/watch?v=PoiFmnFiTS4
4. https://www.youtube.com/watch?v=4liAb3LiOXo
5. https://www.youtube.com/watch?v=r6uN3f9o5PQ

Course Outcomes (COs):

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

1. Analyze the combustion phenomenon and solve the practical problems associated with the performance parameters of the Internal combustion engine and create awareness of current advancement in I C engines (PO1, 2, 3, 4, 6) (PSO1, 2)
2. Apply the knowledge of thermodynamics in the analysis of air standard and gas turbine cycles and determine cycle efficiency, work output and heat supply. (PO1, 2, 3, 4) (PSO1, 2)
3. Solve practical problems on steam nozzles, gas turbines and make modifications to improve Rankine cycle efficiency (PO1, 2, 3, 4) (PSO1, 2)
4. Evaluate the performance parameters of single and multistage air compressors and analyze the different types of refrigeration systems for given comfort conditions. (PO1, 2, 3, 4,6) (PSO1, 2)
5. Solve the problems on design of air conditioning systems with the use of the psychrometric chart and develop the ability to apply the concept of air conditioning systems to solve design problems of real systems. (PO1, 2, 3, 4,6) (PSO1, 2).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1 & CO2
Internal test-II	30	CO3, CO4 & CO5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment/Quiz	10	CO1,CO2,CO3 CO4,CO5
MiniProject/seminar/Presentation/Group activity	10	CO1,CO2,CO3 CO4,CO5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO1,CO2, CO3, CO4 & CO5

MECHANICAL MEASUREMENTS & METROLOGY	
Course Code: ME43	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Jyothilakshmi. R	

Course

Content Unit

I

Standards of Measurement: Definition and Objectives of metrology, Standards of length– International prototype meter, Imperial Standard yard, Wave length standard, subdivision of standards, line and end standard, comparison, transfer from line standard to end standard, calibration of end bars (Numerical), Slip gauges, wringing phenomena, Indian Standards (M-81, M- 112), Numerical Examples on building of slip gauges.

System of limits, Definition of tolerance, Specification in assembly, Principle of inter changeability and selective assembly limits of size, Indian Standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Animated Videos
- Links: Standards of Measurement https://www.youtube.com/watch?v=U8y48L_qn6E&t=214s
- Links: Slip Gauges: https://www.youtube.com/watch?v=CnSRaTTeNrk
- Lab component/Practical topics: Slip Gauge, Micrometer

Unit II

Fits, Tolerances and gauging & Comparators: Definition of fits, types of fits and their designation (IS 919-1963), geometrical tolerance, positional – tolerances, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (principles), Wear allowance on gauges, Types of gauges – Plain plug gauge, ring Gauge, snap gauge, limit gauge and gauge materials.

Introduction to Comparators, Characteristics, classification of comparators, mechanical comparators

–Sigma Comparators, dial indicator, Optical comparators – principles, Zeiss ultra Optimeter.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Animated Videos
- Links: Limits, Fits and Tolerances: https://www.youtube.com/watch?v=G8TSfAeQRaw
- Links: Mechanical Comparators: https://www.youtube.com/watch?v=bKLUtRLL8tY
- Lab component/Practical topics: LVDT, Pneumatic Comparator

Unit III

Angular measurement, Interferometer and Screw thread gear measurement: Angular measurements, Bevel Protractor, Sine Principle and use of Sine bars, Sine center, use of angle gauges,(numericals on building of angles) Clinometers. Interferometer Principle of interferometery, autocollimator. Optical flats. Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire

method, Best size wire.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Animated Videos Links: Angular Measurement: https://www.youtube.com/watch?v=saoOUXYXde0
- Links: Autocollimator: https://www.youtube.com/watch?v=joKSUJm2v2Q
- Lab component/Practical topics: Sine Bar, Sine Centre, 2 Wire and 3 Wire Method, Autocollimator, Screw thread measurement using Tool maker's microscope, Gear Tooth

Unit IV

Measurements and Measurement systems, Intermediate modifying and terminating devices: Definition, Significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in Measurements, classification of errors. Transducers, Transfer efficiency, Primary and Secondary transducers, Electrical, Mechanical, Electronic transducers, advantages of each type transducers. Mechanical systems, inherent problems, Electrical intermediate modifying devices, Input circuitry, Ballast, Ballast circuit and telemetry. Terminating devices, Mechanical, Cathode Ray Oscilloscope, Oscillographs.

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation, Animated Videos
- Links: Generalized Measurement System:https://www.youtube.com/watch?v=PEpL0ukTWhs
- Links: Intermediate modifying and terminating devices, inherent problems: https://www.youtube.com/watch?v=5wqaGZICdTI
- Lab component/Practical topics:-Calibration of Pressure Transducer, Micrometer, Load Cell

Unit V

Measurement of Force and Torque, Pressure Temperature and Strain Measurement: Principle, Analytical balance, platform balance,Hydraulic dynamometer. Pressure Measurements, Principle, use of elastic members, Bridgeman gauge, McLeod gauge. Temperature and Strain Measurement: Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, Pyrometer, Optical Pyrometer. Strain Measurements, Strain gauge, preparation andmounting of strain gauges, gauge factor, methods of strain measurement.

Coordinate measuring machine: Introduction, design, types and its applications.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Animated Videos
- Links: Torque Measurement: https://www.youtube.com/watch?v=ydyVsVk96z8
- Links: Coordinate Measuring Machine: https://www.youtube.com/watch?v=xgDpq4orAFM
- Lab component/Practical topics: Thermocouple, Coordinate Measuring Machine

Text Books:

1. Mechanical measurements, by Beckwith Marangoni and Lienhard, Pearson Education, 6thEd., 2006.
2. Engineering Metrology, by R.K.Jain, Khanna Publishers,5th edition 2006.

Reference Books:

1. Engineering Metrology, by I.C.Gupta, Dhanpat Rai Publications, Delhi. 2nd edition 2006 edition.
2. Industrial Instrumentation, Alsutko, Jerry.D.Faulk, Thompson Asia Pvt. Ltd.1st edition 2002.
3. Measurements Systems Applications and Design, by Ernest O. Doblin, McGraw Hill Book Co. 2nd edition. 2006

Web links and video lectures (e-Resources):

1. https://www.youtube.com/watch?v=Pn7VHO1LOAw
2. https://www.youtube.com/watch?v=HpIEeBtJupY&list=PLbMVogVj5nJSZiwuh_tp50dKry8 mCxzKA
3. https://www.youtube.com/watch?v=8DTt-f6wQxE&list=PL41FA714195562989
4. https://www.youtube.com/watch?v=tN7iAzVEqa0&list=PLwdnzlV3ogoXJLQ8lSGb1hsztt24 l9kZZ
5. https://www.youtube.com/watch?v=_tFL-oOyVtM

Course Outcomes (COs):

1. Explain the concept of measurements in engineering. (PO1,2,4,7,8, PSO1,2)
2. Examine the applications of Limits, Fits, Tolerances and Analyse comparators for different engineering applications. (PO1,2,4,7,8,PSO1,2)
3. Identify the uses of Gauges for Angular measurement, Screw thread and Gear Measurement. (PO1,2,3,4,)(,PSO1,2)
4. Understand the significance of measurement system, Errors, Transducers, Intermediate modifying and terminating devices. (PO1,2,3,4,7,8,PSO1,2)
5. Apply the techniques for force, torque, pressure, temperature and strain measurement systems (PO1,2,3,4,7,8),PSO1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1 ,CO2 and CO3
Internal test-II	30	CO3, CO4 & CO5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment/Quiz	10	CO1,CO2,CO3 CO4,CO5
MiniProject/Seminar/Presentation/Group activity	10	CO1,CO2,CO3 CO4,CO5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO1,CO2, CO3, CO4 & CO5

MANUFACTURING PROCESSES - II	
Course Code: ME44	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 45L+45S**
Course Coordinator: Mr. NISHANTH ACHARYA	

Course Content

Unit I

Fundamentals of Metal Cutting: Introduction, Basic elements of machining, Orthogonal and oblique cutting, Classification of cutting tools, Principal angles of single point cutting tools, Tool signature, Chip formation, Types of chips, Chip thickness ratio, chip breakers, Velocity relationships, Force relationship in orthogonal cutting, Stress and strain in chip, Work done in cutting, Horse power calculation, Sources of heat in metal cutting, Numerical problems.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Nomenclature of Single point cutting tool: https://www.youtube.com/watch?v=BHEYrGrvp6U
- Links: Chip formation, Types of chips, Chip thickness ratio: https://www.youtube.com/watch?v=u7lpccLxuMI

Unit II

Cutting Tool Materials: Tool failure, Mechanism of wear, Tool life, Factors affecting tool life, desirable properties of cutting tool materials, Machinability, Machinability index. Cutting fluids, functions, requirements, types of cutting fluids

Turret & Capstan lathes and Automatic machines: Introduction, Main parts of a Turret & capstan lathe, Differences between Turret & capstan lathe, Classification of Turret lathe, Primary and secondary motions, bar feed mechanism, Turret index and stop drum mechanisms

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Tool failure, mechanism of wear: https://www.youtube.com/watch?v=eCD2g1njeZQ
- Links: Turret & Capstan lathes: https://www.youtube.com/watch?v=hbNmMYoIAtg

Unit III

Milling: Introduction, working principle in milling, milling cutter nomenclature, Types of milling machines-horizontal, vertical and fixed bed type plain milling machines, milling operations, Indexing or dividing head, Indexing methods and Numerical problems.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Types of milling machines: https://www.youtube.com/watch?v=aeOaAZRwpfY
- Links: milling indexing: https://www.youtube.com/watch?v=a-GkDjXGJI0

Unit IV

Drilling: Introduction, Twist drills parts and nomenclature, Types of drilling Machines-Bench and Radial, drilling operations, cutting speeds, feeds and depth of cut time with Numerical.

Grinding: Introduction, Common forms of abrasive tools, Wheel material, Symbolic representation of bonds, Grain, Grade, Structure, Loading, glazing Trueing and dressing of grinding wheels, Wheel balancing, Use of coolants, centerless grinder, cylindrical Grinder-Plain and universal.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Types of drilling machine: https://www.youtube.com/watch?v=w08kcbMhBho
- Links: Loading, glazing Trueing and dressing of grinding wheels, https://www.youtube.com/watch?v=p-B-Qs-jCxI

Unit V

Jigs and Fixtures: Introduction, Differences between jigs and fixtures, important consideration in jigs and fixture design, Main elements of jigs and fixtures, types of locating and clamping devices, basic requirements.

Powder Metallurgy: Basic steps in Powder metallurgy, Production of metal powders, blending of metal powders, Compaction, Sintering and Finishing, Application, advantages and limitations of powder metallurgy.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Jigs and Fixtures: https://www.youtube.com/watch?v=ko0_d7EDsTQ
- Links: Powder Metallurgy: https://www.youtube.com/watch?v=AZMbSBVVWhI

Text Books:

1. A Course in Workshop Technology, Volume II (Machine Tools), B.S. Raghuwanshi, Dhanpat Rai Publication, 2012
2. Processes and Materials of Manufacture, 4th Edition, Roy A. Lindberg, PHI Learning Publication, 2008

Reference Books:

1. Fundamentals of Metal Machining and Machine Tools, 3rd Edition, Winston A. Knight, Geoffrey Boothroyd, Taylor and Francis Publication, 2005
2. Production Technology, Volume I, O.P.Khanna, Dhanpat Rai Publication, 2015.

Course Outcomes (COs):

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

1. Recognize the various cutting forces acting in metal cutting on cutting tool materials and their tool life (PO1,2,3 & PSO1)
2. Understand the working of Capstan and Turret lathes, drilling machine, reaming machine, milling machine and grinding machines. (PO1,2 & PSO1)
3. Apply the design aspects of jigs and fixture and the recent advancement in the areas of machining in terms of numerically controlled machine tool. (PO1,2,3 & PSO1)
4. Comprehend the preparation of powders, mixing, compaction and sintering of various components using powders metallurgy techniques. (PO1,2,6 & PSO1)
5. Demonstrate the knowledge in machining and newer techniques adopted in industries to solve the real-world problems in production. (PO1,2,6 & PSO1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1 ,CO2 and CO3
Internal test-II	30	CO3, CO4 & CO5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment/Seminar	10	CO1,CO2,CO3 CO4,CO5
Quiz /Case-study/Real-life examples	10	CO1,CO2,CO3 CO4,CO5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO1,CO2, CO3, CO4 & CO5

FLUID MECHANICS	
Course Code: MEE451	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 45L+45S**
Course Coordinator: Smt. Bijayalakshmi Das	

Course content

UNIT I

Properties of Fluids & Fluid Statics

Definition of fluid and continuum concept, Classification of fluids: Ideal and real fluids, Newtonian and non-Newtonian fluids, Compressible and incompressible fluids

Physical Properties of Fluids: Density, specific weight, specific volume, Specific gravity, Viscosity (dynamic and kinematic), Newton's law of viscosity, Variation of viscosity with temperature, Surface tension and capillarity, Vapor pressure and cavitation, Compressibility and bulk modulus

Fluid Statics: Fluid Pressure at A Point, Pascal's Law, Pressure Variation In A Static Fluid, Total Pressure And location of Center Of Pressure on horizontal/vertical/inclined plane surfaces.

- plane surfacesPedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links:Introduction to Product Design,Morphology: https://www.youtube.com/watch?v=G2f1_gCk9HM

UNIT II

Buoyancy and flotation: Buoyancy, center of buoyancy, metacenter and metacentric height, conditions of equilibrium of floating and submerged bodies.

Fluid Kinematics: Description of Fluid Motion: Lagrangian and Eulerian descriptions. Types of flow: steady/unsteady, uniform/non-uniform, laminar/turbulent F**low** Visualization: Streamline, pathline, streakline, Stream tube. Continuity Equation in 3D Cartesian coordinate system.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links:https://www.youtube.com/results?search_query=NPTEL+Fluid+Kinematics+Lagrangian+Eulerian

UNIT III

Fluid Dynamics: Newton's second law for fluid motion, Euler's equation of motion, Bernoulli's equation and its derivation, Assumptions and limitations, Applications of Bernoulli's equation: Venturimeter, Orificemeter, Pitot tube.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: https://www.youtube.com/watch?v=g_5bo-Cw-3w

UNIT IV

Laminar flow: Flow through circular pipes, Hagen– Poiseuille equation, Flow between parallel plates,

Turbulent Flow: Reynolds number and flow regimes, Darcy–Weisbach equation, Friction factor

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation

- Links:https://www.youtube.com/results?search_query=Hagen+Poiseuille+equation+fluid+mechanics+NPTEL

UNIT V

Dimensional Analysis: Dimensions and units, Dimensional homogeneity, Rayleigh method, Buckingham π-theorem, Model analysis and similitude

Boundary layer theory: Boundary layer concept, Boundary layer thickness, Displacement and momentum thickness, Drag and lift forces.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: https://www.youtube.com/watch?v=T3cuyNXg_pY

Text books:

1. Fluid Mechanics by Dr. Bansal. R.K
2. Fluid Mechanics by Modi & Seth

Reference books:

1. R.K. Rajput – Fluid Mechanics and Hydraulic Machines*, S. Chand.*
2. Cengel,Y.A.& Cimbala,J.M.-Fluid Mechanics: Fundamentals and Applications, McGraw-Hill

Course Outcomes:

1. Explain and classify fluid properties and apply fluid statics principles to determine pressure forces and centers of pressure.(PO1,PO2,PO5,PO11,PSO1)
2. Analyze buoyancy, flotation, and kinematics of fluid flow using continuity and flow visualization concepts. (PO1,PO2,PO5,PO11, PSO1 & PSO2)
3. Apply Euler's and Bernoulli's equations to *solve* problems involving flow measurement devices. (PO1,PO2,PO3,PO4,PO5, PO11, PSO1 & PSO2)
4. Analyze laminar and turbulent flow in pipes and between plates and estimate frictional losses. (PO1,PO2,PO3,PO4,PO5, PO11, PSO1 & PSO2)
5. Apply dimensional analysis and boundary layer theory to predict model–prototype behavior and drag/lift forces.((PO1,PO2,PO3,PO4,PO5, PO6,PO11, PSO1 & PSO2).

Course Assessment and Evaluation

Continuous Internal Evaluation- 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1,CO-2, CO-3
Quiz	10	CO-4 & CO-5
Semester End Examination- 100 Marks		
Semester End Examination	100	CO-1,CO-2, CO-3, CO-4 & CO-5

CRYOGENICS	
Course Code: MEE452	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 445L+45S**
Course Coordinator: Dr. NIRANJAN MURTHY	

Course Content

Unit I

Introduction to Cryogenic Systems:

Properties of materials at low temperatures, Cryogenic propellants and its applications, liquid hydrogen, liquid nitrogen, and liquid Helium

The thermodynamically Ideal system Production of low temperatures – Joule Thompson Effect, Adiabatic expansion.

Gas Liquefaction Systems:

Liquefaction systems for Air Simple Linde –Hampson System, Claude System, Heylndt System, Dual pressure, Claude. Liquefaction cycle Kapitza System. Comparison of Liquefaction Cycles Liquefaction cycle for hydrogen, helium and Neon, Critical components liquefaction systems.

Link:https://www.youtube.com/watch?v=VNUhNBRy9Ho&t=3s

Link: https://www.youtube.com/watch?v=oEiFNJMXRNg

Unit II

Gas Cycle Cryogenic Refrigeration Systems:

Classification of Cryo coolers Stirling cycle Cryo – refrigerators, Ideal cycle – working principle. Schmidt's analysis of Stirling cycle, Various configurations of Stirling cycle refrigerators, Integral piston Stirling cryo-cooler, Free displacer split type Stirling Cryo coolers, Gifford Mcmahon Cryo-refrigerator, Pulse tube refrigerator, Solvay cycle refrigerator, Vuillimier refrigerator, Cryogenic regenerators.

Unit III

Gas Separation and Gas Purification Systems

Thermodynamic ideal separation system, Properties of mixtures, Principles of gas separation, Linde single column air separation. Linde double column air separation, Argon and Neon separation systems.

Link: https://www.youtube.com/watch?v=VNUhNBRy9Ho&t=1s

Link: https://www.youtube.com/watch?v=oEiFNJMXRNg

Unit IV

Vaccume Technology: Fundamental principles. Production of high vacuum, Mechanical vacuum pumps, Diffusion pumps, Cryo-pumping, Measurement of high vacuum level. Cryogenic Insulation: Heat transfer due to conduction, Evacuated porous insulation Powder &Fibers Opacified powder insulation, Gas filled powders & Fibrous materials Multilayer super-insulation, Composite insulation.

Unit V

Cryogenic Fluid Storage and Transfer Systems

Design of cryogenic fluid storage vessels, Inner vessel, Outer Insulation, Suspension system, Fill and drain lines. Cryogenic fluid transfer, External pressurization, Self-pressurization, Transfer pump.

Application of Cryogenic Systems

Cryogenic application for food preservation – Instant Quick Freezing Techniques Super conductive devices, Cryogenic applications for space technology. Application of cryogenic systems, super conducting devices, space technology, cryogenic in biology and medicine.

Text Books:

Cryogenic Systems – R.F. Barron

Cryogenic Engineering –R.B. Scott – D.Van Nostrand Company,1959

Reference Books:

Cryogenic Process Engineering – K.D. Timmerhaus and T.M. Flynn, Plenum Press, New York,1989

High Vacuum Technology – A. Guthree – New Age International Publication

Experimental Techniques in Low Temperature Physics – G.K. White – Osford University Press

Course Outcomes (COs):

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

CO1 Explain the properties of cryogenic fluids, low-temperature thermodynamics, and the principles involved in the production of cryogenic temperatures through Joule-Thomson expansion and adiabatic expansion. [PO: 1,2 Pso1,Pso2]

CO2 Analyze and compare various gas liquefaction and cryogenic refrigeration systems such as Linde-Hampson, Claude, Stirling, Gifford-McMahon, Pulse Tube, and Vuilleumier refrigerators. [PO: 1,2 , 3,4,5, Pso1,Pso2]

CO3Apply thermodynamic principles to gas separation and purification processes, including air separation and noble gas recovery systems. [PO: 1,2 , 3,4,5, Pso1,Pso2]

CO4Evaluate vacuum generation techniques, cryogenic insulation systems, and heat transfer

mechanisms for efficient cryogenic operation. [PO: 1,2 , 3,4,5,7, Pso1,Pso2]

CO5Design and assess cryogenic storage and transfer systems and investigate the role of cryogenic technologies in food preservation, superconductivity, medicine, biology, and space applications. [PO: 1,2 , 3,4,5,7,9,10,11, Pso1,Pso2]

CourseAssessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test – I	30	CO1,CO2,CO3
Internal test – II	30	CO3,CO4,CO5
Average of the two internal tests will be taken for 30 marks.		
Other components		
Assignment/Quiz	10	CO1,CO2,CO3 CO4,CO5
Surprise test	10	CO1,CO2,CO3 CO4,CO5
Semester End Examination (SEE)	100	CO1,CO2,CO3,CO4,CO5

THEORY OF ELASTICITY	
Course Code: MEE453	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Mahantesh S Matur	

Course Content

Unit I

Definition and Notations: Stress, Stress at a point, equilibrium equations, equality of cross shear stress, principal stress, octahedral stress, boundary condition equations, stress on an inclined plane.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Lab component/ Practical topics: Material Testing Laboratory
- Links: principal stress, octahedral stress https://www.youtube.com/watch?v=9a5lI7rc6fA
- Links: stress on an inclined plane https://www.youtube.com/watch?v=dPS-ayLYcJg

Unit II

Strain at A Point Compatibility equations, principal strains, Mohr's Diagram Generalized Hooke's Law, Plane stress and Plain Strain, Aeris Stress Function, Analysis of beams, cantilever beam.

- Pedagogy/ Course delivery tools: Chalk and talk
- Lab component/ Practical topics: Design and Dynamics Laboratory
- Links:Compatibility equations, principal strains, Mohr's Diagram Generalized Hooke's Law https://www.youtube.com/watch?v=m8Z0ObvSVxM
- Links: Plane stress and Plain Strain, Aeris Stress Function, Analysis of beams, cantilever beam https://www.youtube.com/watch?v=P5jlJ6_joQ8

Unit III

General Equation in Cylindrical Coordinators, Equilibrium equations, analysis of thick cylinder subjected to internal and external pressure, shrink fits.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation.
- Lab component/ Practical topics: Material Testing Laboratory
- Links: General Equation in Cylindrical Coordinators https://www.youtube.com/watch?v=NS8Y8tiMACI
- Links: analysis of thick cylinder subjected to internal and external pressure https://www.youtube.com/watch?v=EpKT-jySYIU

Unit IV

Stresses in Rotating Discs and Cylinders, Stress Concentration in an infinite plate. Thermal Stresses, Thermo elastic stress strain relation, thermal stresses in think circular disc and long cylinders.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation.
- Lab component/ Practical topics: FEA Laboratory
- Links: Stresses in Rotating Discs and Cylinders https://www.youtube.com/watch?v=J1Q8ssJikOc
- Links: Thermal stresses in think circular disc and long cylinders https://www.youtube.com/watch?v=JCEIQqcmYGY

Unit V

Principal of superposition theorem, Saint Venant's principle, uniqueness theoretician of circular, elliptical and triangular bar, membrane analogy

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation.
- Lab component/ Practical topics: FEA Laboratory.
- Links: Saint Venant's principle, uniqueness theoretician of circular https://www.youtube.com/shorts/l2zd41swi0M
- Links: Membrane analogy https://www.youtube.com/watch?v=bf8_rkcKrdQ

Text Books:

1. Theory of Elasticity – SP Timoshenko and Goodier, Mc Graw Hill International, 3rd Edition 1972
2. Advanced Mechanics of Solids – L S Srinath – Tata Mc Graw Hill.

Reference Books:

1. Applied Elasticity – CT Wang, Mc Graw Hill Book 1953
2. Elasticity Theory applications and numericals – Martin H Sadd, Elsiver 2005

Course Outcomes (COs):

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

1. Evaluate and compare the conventional strength of material approach and that of TOE (PO1, 2, 3, 4, and PSO1 &2)
2. Compile fundamentals of TOE for engineering applications. (PO1,2,3,4, PSO1 &2)
3. Develop ability to identify a problem and apply the fundamental concepts of TOE. Demonstrate the ability to solve problems of practical interest. (PO1,2,3,4, PSO1 &2)
4. Develop competence to design and analyze problems of engineering involving design of components (PO1, 2, 3, 4, 5 and PSO1 &2)
5. Demonstrate ability to have the competence for undergoing knowledge up gradation in the field of TOE with particular reference to Theory of Plasticity and Finite Element Method. (PO1, 2, 3, 4, 5, PSO1 &2)

Course Assessment and Evaluation

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1 &CO2
Internal test-II	30	CO3, CO4 & CO5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO1,CO2, CO3
Quiz	10	CO4 & CO5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO1,CO2, CO3, CO4 & CO5

Machine Tool Design	
Course Code: MEE454	**Credits: 3:0:0**
Pre – requisites: Mechanics of Materials	**Contact Hours: 45L+45S**
Course Coordinator: Dr.Aruna Kumara P C	

Course Content

Unit I

Introduction to Machine Tool Design: Classification of machine tools, General design considerations. Functional requirements of machine tools, machine tool structures and materials.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links:https://www.youtube.com/watch?v=rHkbPcDgju0&list=PLQmc-I2-FO2HTjIKRUw9WPIs61FVZZ7Ng

Unit II

Guideways and Structural Design: Types of guideways: sliding, rolling, hydrostatic, aerostatic. Design of slideways and guideways, Friction, wear, and lubrication in guideways. Structural design of beds, columns, and frames. Analysis of machine tool structures, deformation, and stiffness calculations.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://www.youtube.com/watch?v=3xkG1lie9eA

Unit III

Spindle and Bearing Design: Spindle functions and requirements, Spindle design principles, Critical speed of spindle. Bearing types: rolling, hydrodynamic, hydrostatic bearings, bearing selection and life calculations, and Thermal effects in spindle systems.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://www.youtube.com/watch?v=rDZrUtZbaoA&t=36s

Unit IV

Feed Drives and Transmission Systems: Feed mechanisms and kinematics, lead screws, ball screws, and recirculating systems. Gear trains in machine tools.Belt and chain drives, clutches, and brakes.Power transmission design considerations.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos

- Links:https://www.youtube.com/watch?v=cCRhbYZYbNc&list=PLW8dmBubHmIqnB8gSUieg2w6XyQr-vXiP

Unit V

Dynamics, Control and Modern Machine Tools: Vibrations in machine tools, Chatter and its control. Damping techniques, Thermal deformation and compensation. CNC machine tool design concepts. Mechatronics in machine tools. Modern trends: smart machines, AI-based monitoring.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://www.youtube.com/watch?v=gUPuzReDieE

Textbooks:

1. **A.Ghosh & A.K. Mallik**, *Manufacturing Science*, East-West Press.
2. **H.A. Tobias**, *Machine Tool Vibration*, Blackie & Sons.
3. **N.K. Mehta**, *Machine Tool Design*, McGraw Hill Education.
4. **S. Kalpakjian & S. Schmid**, *Manufacturing Engineering and Technology*, Pearson Education.

Reference Books:

1. **J.A. Schey**, *Introduction to Manufacturing Processes*, McGraw-Hill.
2. **Raghuwanshi & Karmakar**, *Manufacturing Technology*, Dhanpat Rai.
3. **Geoffrey Boothroyd et al.**, *Product Design for Manufacture and Assembly*, CRC Press.
4. **V.B. Bhandari**, *Design of Machine Elements*, McGraw-Hill.

Course Outcomes (COs):

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

1. Explain the fundamentals of machine tool design, classification, functional requirements, materials, rigidity, accuracy, and safety considerations.(PO1,PO2,PO3,PO6,PO7,PO10)
2. Analyze and design machine tool structures and guideways considering stiffness, deformation, wear, friction, and lubrication requirements.(PO1,PO2,PO3,PO4,PO5,PO7,PO10)
3. Apply design principles for spindle systems and bearings considering critical speed, bearing selection, life calculations, and thermal effects(PO1,PO2,PO3,PO4,PO5,PO7,PO10).
4. Design and evaluate feed drives, transmission systems, lead screws, ball screws, gear trains, and power transmission mechanisms. (PO1, PO2, PO3, PO4, PO5, PO9, PO10,PO11)
5. Analyze machine tool dynamics, vibrations, chatter, thermal deformation, CNC concepts, and modern smart machine tool technologies.(PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO9,PO10,PO11)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test – I	30	CO1,CO2,CO3
Internal test – II	30	CO3,CO4,CO5
Average of the two internal tests will be taken for 30 marks.		
Other components		

Assignment/Quiz	10	CO1,CO2,CO3 CO4,CO5
Surprise test	10	CO1,CO2,CO3 CO4,CO5
Semester End Examination (SEE)	100	CO1,CO2,CO3,CO4,CO5

TOOL ENGINEERING	
Course code: MEE455	**Course Credits: 3:0:0**
Prerequisite: Nil	**Contact Hours: 45L+45S**
Course Coordinator: Dr.D.K.Vishwas	

Course content

UNIT I

Tool Design Methods- The Design Procedure, Statement of the Problem, The Needs Analysis, Research and Ideation, Tentative Design Solutions, The Finished Design.
Tool Making Process- Introduction, Tools of the Toolmaker, Hand Finishing and Polishing, Screws and Dowels, Hole Location, Jig-boring Practice, Installation of Drill Bushings, Punch and Die Manufacture,

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: Introduction to Product Design,Morphology: https://youtu.be/4j5tj3wF3ig

UNIT II

Tooling Materials- Introduction, Properties of Materials
Ferrous Tooling Materials- Tool Steels, Cast Iron, Mild, or Low-carbon, Steel, Non-metallic Tooling Materials, Nonferrous Tooling Materials, Appearance of Carbon in Steel
Locating and Clamping Methods- Introduction, Basic Principles of Location, Locating Methods and Devices, The Basic Principles of Clamping

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: https://youtu.be/JHWgnuwrD7c

UNIT III

Introduction-Injection Moulding

Machine Characteristics, Molding Plastics,
Molding Basics and Overview- and Overview People and Productivity, Plastic Materials, Morphology and Performance, Melt Flow and Rheology, Plasticating, Screw Designs, Molds, Processing, Process Controls, Control Guides, Art of Processing, Fine Tuning, Molding Operations-Automatic, Semiautomatic, Manual, Primary Secondary Injection Molding Machines- Introduction, Reciprocating (Single-Stage) Screw Machines, Two-Stage Machines, Reciprocating vs. Two-Stage Machines

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: https://youtu.be/QTi0Mv7DGDs

UNIT IV

Injection Molding Machines- Clamping Systems- Clamping Pressures, Hydraulic

Clamps, Toggle Clamps, Hydromechanical Clamps, Hydroelectric Clamps,
Comparison of Clamp Designs, Tie-bars, Tie-barless Systems, Platen Systems
Plasticizing- Introduction- Plasticators- Plastics Melt Flow, Barrel Temperature Override
Screw Sections- Feed Section, Transition Section, Metering Section
Elements of the Plasticating Processes- Screw Rotation, Soak Phenomena, Injection stroke, Injection Pressure

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: https://youtu.be/1GRvasLjPag

UNIT V

Molds to Products- Interrelation of Plastic, Process, and Product, Molding Process Windows, Cycle Times, Molding Pressure Required

Fundamentals of Designing Products- Overview, Molding Influences Product Performance, Design Optimization, Material Optimization, Material Characteristics, Behaviour of Plastics- Thermal Stresses,

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation

REFERENCE BOOKS

1. **Production Technology**- HMT, McGraw Hill Education2017
2. **Production Technology,** Volume I, O.P.Khanna, Dhanpat Rai Publication, 2015.

TEXT BOOKS

1. **Injection Molding Handbook** -Dominick V Rosato, Donald V Rosato, Marlene G Rosato, Springer+ Business Media,New York, 2000
2. **Tool Design** - Cyril Donaldson (Author), H. LeCain George (Author), V. C. Goold (Author), Joyjeet Ghose (Author), McGraw Hill Education2017

Course Outcomes:

1. Apply systematic tool design methods and perform basic tool making operations, including accurate hole location, installation of drill bushings (PO1,PO2,PSO1,PSO2)
2. Analyze and classify tooling materials based on their properties, explain the role of carbon in steel, and apply the basic principles of locating and clamping methods for proper selection and use of tooling in manufacturing processes. (PO1,PO2,PO5,PSO1,PSO2)
3. Understand the fundamentals of injection moulding, plastic materials and processing, and compare injection moulding machines to select suitable methods for efficient production. (PO1,PO2,PO3,PO4,PSO1,PSO2)
4. Demonstrate the knowledge clamping systems and plasticizing mechanisms in injection molding machines, and explain the role of screw design, melt flow, and processing parameters in achieving efficient and controlled molding operations(PO1,PO2,PO3,PO4,PSO1,PSO2)
5. Identify and locate the interrelationship between plastic materials, molding processes, and product design, and explain how process windows, cycle time, pressure, and material behavior influence product performance. (PO1,PO2,PO3,PO4,PO5,PSO1,PSO2)

Course Assessment and Evaluation

Continuous Internal Evaluation- 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1,CO-2, CO-3
Quiz	10	CO-4 & CO-5
Semester End Examination- 100 Marks		
Semester End Examination	100	CO-1,CO-2, CO-3, CO-4 & CO-5

NON-TRADITIONAL MACHINING	
Course Code: MEE456	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Mohandas K N	

Course

Content

Unit I

Introduction to NTM, Classification of NTM, Comparison between conventional and Non-Traditional process.

Ultrasonic Machining: Introduction, Equipment, Tool material and tool size, Abrasive slurry, cutting tool system design, Effect of parameter: effect of amplitude, frequency, Effect of vibration, abrasive diameter, Effect of applied static load, slurry, tool and work material, USM process characteristics: MRR, tool wear, accuracy, surface finish, Application, advantages and disadvantages of USM.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: Non-traditional machining https://www.youtube.com/watch?v=jhM01_mwygg
- Links: Ultrasonic machining https://www.youtube.com/watch?v=E4VZ_rFqpG4

Unit II

Abrasive Jet Machining: Introduction, Equipment, Variables in AJM, Carrier gas, types of abrasive, size of abrasive grain, Velocity of the abrasive jet, mean number, abrasive particles/Unit volume of carrier gas, Work material, stand-off distance, nozzle design, shape of cut, Process characteristics: MRR, nozzle wear, accuracy, surface finish, Applications, advantages and disadvantages of AJM.

Water Jet Machining: principle, equipment, operation, Applications, advantages and limitations of WJM.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: Abrasive Jet Machining https://www.youtube.com/watch?v=FYOsuqdD274
- Links: Water Jet Machining https://www.youtube.com/watch?v=3yV-uJHla58

Unit III

Chemical Machining: Introduction, elements of process, Chemical blanking process: preparation of work piece, Preparation of masters, masking with photo resists, etching for blanking, Accuracy, applications of chemical blanking, chemical milling, Process steps-masking, etching, process characteristics of CHM, MRR, accuracy, surface finish, hydrogen embrittlement, Advantages and application of CHM.

Electro Chemical Machining: Introduction, study of ECM machine, elements of ECM, Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of process, ECM process characteristics,-MRR, accuracy, surface finish, ECM tooling: ECM tooling technique and Example, Tool and insulation materials, tool size, electrolyte flow

arrangement, Handling of slug, Economics of ECM, applications such as electrochemical turning, Electrochemical grinding, Electrochemical honing, deburring, advantages, limitations.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: Chemical Machining https://www.youtube.com/watch?v=KfJ85mjpWx4
- Links: Electro Chemical Machining https://www.youtube.com/watch?v=fOc65syJvDM

Unit IV

Electro Discharge Machining: Introduction, Mechanism of material removal, Dielectric fluid, Spark generator, EDM tools, electrode feed control, electrode manufacture, Electrode wear, EDM tool design, choice of machining operation, Electrode material selection, under sizing, length of electrode, machining time, Flushing, pressure flushing, suction flushing, Side flushing, pulsed flushing, EDM process characteristics: MRR, accuracy, surface finish, HAZ, machine tool selection, Application, EDM accessories/ applications, Electric discharge grinding, traveling wire EDM.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: Electro Discharge Machining https://www.youtube.com/watch?v=rA09KaPL7_8

Unit V

Plasma Arc Machining: Introduction, equipment, nonthermal generation of plasma, Selection of gas, Mechanism of metal removal, PAM parameter, Process characteristics, safety precautions, applications, advantages and limitations. **Laser Beam Machining:** Introduction, equipment of LBM, Mechanism of metal removal LBM parameters, process characteristics, Advantages, limitations.

Electron Beam Machining: principles, Equipment, operations, Applications, advantages, limitations of EBM.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: Plasma Arc Machining https://www.youtube.com/watch?v=kvlBEoLiOGw&t=454s
- Links: Laser Beam Machining https://www.youtube.com/watch?v=mgaukC25Hqk
- Links: Electron Beam Machining https://www.youtube.com/watch?v=pkikv0RHWTA

Text Books:

1. Modern Machining Processes, Pandey, P.C. and Shan, H. S., Tata McGraw Hill Publications (2018).
2. Production Technology, HMT, Tata McGraw Hill, 2010

Reference Books:

1. Advanced Machining Processes, Vijay K Jain, Allied Publishers Mumbai, 2002.
2. Unconventional Manufacturing Process, M K Singh, New Age International, 2010.

Course Outcomes (COs):

After successful completion of this course, students will be able to:

1. **Recognize** the importance of NTM methods and describe Ultrasonic machining processes. (PO1, 2, 7, 11, PSO1 &2)
2. **Demonstrate** the working principle and applicability of the abrasive jet and water jet machining processes. (PO1, 2, 11, PSO1)
3. **Illustrate** the working principle and applicability of the electro-chemical and chemical machining processes. (PO1, 2, 11, PSO1 &2)

4. **Describe** the importance of Electro Discharge machining process, aspects related to MRR, surface finish. (PO1, 2, 7, PSO1 &2)
5. **Illustrate** the working principle, advantages, process limitations of PAM, LBM and EBM processes. (PO1, 7, PSO1 &2)

Course Assessment and Evaluation

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1 & CO2
Internal test-II	30	CO3, CO4 & CO5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other Components - 20 Marks		
Assignment	10	CO1, CO2, CO3
Quiz	10	CO4 & CO5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO1, CO2, CO3, CO4 & CO5

FUNDAMENTALS OF SENSORS AND ACTUATORS	
Course Code: MEAEC46	**Credits:1:0:0**
Pre – requisites: Nil	**Contact Hours: 15L**
Course Coordinator: - Mr. NANDEESH H L	

Course content

UNIT I

Sensors and Transducers: Terminology, Performance, Selection criteria of sensors, Types of sensors and transducers.

- Pedagogy/Course delivery tools: ➢ Chalk and talk, Power point presentation, animated videos
- Links: Basic Concepts about Sensors and Transducers ➢ https://youtu.be/bfw_So5cCp4
- Links: Difference between Transducer and Sensor ➢ https://youtu.be/9eNDKuS3lUE

UNIT II

Applications of Sensors: To measure Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature and Light sensors.

- Pedagogy/ Course delivery tools: ➢ Chalk and talk, Power point presentation, animated videos.
- Links: Different Types of Sensors, Applications ➢ https://youtu.be/XI49uFm5HRE
- Links: Applications by Techmentation Lab ➢ https://youtu.be/ht-_RmhLD7k

UNIT III

Signal conditioning: Introduction, Amplifier, filters, Analog to Digital Convertor and Digital to Analog convertor, Digital Signal processing.

- Pedagogy/ Course delivery tools: ➢ Chalk and talk, Power point presentation, animated videos

- ❖ Links: Operational Amplifier: Characteristics of Ideal Op-Amp. ➢ https://youtu.be/kiiA6WTCQn0
- ❖ Links: ADC and DAC ➢ https://youtu.be/HicZcgdGxZY
- ❖ Links: Digital Signal Processing ➢ https://youtu.be/iCaDt9Esdv4

UNIT IV

Electric actuation system: Working principle and applications of Stepper Motors and AC/ DC Servo motors

- ❖ Pedagogy/ Course delivery tools: ➢ Chalk and talk, Power point presentation, animated videos
- ❖ Links: How a Servo Motor works ➢ https://youtu.be/hg3TIFIxWCo
- ❖ Links: AC/DC servo motors. ➢ https://youtu.be/ditS0a28Sko

UNIT V

Hydraulic and Pneumatic actuation systems: Introduction, hydraulic system & Electro pneumatic system, applications

- ❖ Pedagogy/ Course delivery tools: ➢ Chalk and talk, Power point presentation, animated videos
- ❖ Lab component/ Practical topics: ➢ CIM laboratory
- ❖ Links: How do Hydraulic Actuators work ➢ https://youtu.be/j8ALHGOQTQ0
- ❖ Links: What is a Pneumatic Actuator? | Types & Applications ➢ https://youtu.be/vF61cZerj2M

TEXT BOOKS

1. **D. Patranabis, "Sensors and Transducers", PHI Learning Private Limited.**
2. **W. Bolton, "Mechatronics", Pearson Education Limited.**

REFERENCE BOOKS

1. **Patranabis, "Sensors and Actuators", 2nd Edition, PHI, 2013.**
2. **Measurement Systems (Application & Design), E.D.Doebelin**
3. **Transducers & Instrumentation, Rangan Mani Sharma**
4. **Silicon Sensors, Middlehock**

Course Outcomes:

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

1. Acquire knowledge on different types of sensors used in day to day using gadgets and devices. (PO1,PO5, and PSO1, PSO2)
2. Measuring the various mechanical attributes using advanced sensors. (PO1,PO2,PO3,PO9 and PSO1, PSO2)
3. Able to convert the acquired signals from digital to analog & analog to digital, and diploid in current systems . (PO1,PO2,PO3,PO5 and PSO1, PSO2)
4. Understand the fundamental of AC/DC motor working principles and their controlling by servo system in the industrial world. (PO1,PO2 and PSO1, PSO2)
5. Realize the importance of actuation system in hydraulic and pneumatic domain for accurate movement of stuffs. (PO1,PO2, and PSO1, PSO2)

Course Assessment and Evaluation

Continuous Internal Evaluation- 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1 &CO2
Internal test-II	30	CO3, CO4 & CO5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment/Quiz	10	CO1,CO2,CO3 CO4,CO5
Mini Project/seminar/Presentation/Group activity	10	CO1,CO2,CO3 CO4,CO5
Semester End Examination- 100 Marks		
Semester End Examination	50	CO1,CO2, CO3, CO4 & CO5

APPLIED THERMODYNAMICS LABORATORY	
Course Code: MEL47	**Credits: 0:0:1**
Pre – requisites: Nil	**Contact Hours: 30P**
Course Coordinator: Dr. P B Nagaraj	

Course Content

Unit I

PART A
List of Experiment

1. Determination of Flash and Fire point of Light, medium and heavy oils.
2. Determination of solid fuel calorific value using Lewis Thomson Calorimeter
3. Determination of viscosity of oil using Redwood Viscometer.
4. Determination of viscosity of oil using Torsion Viscometer.
5. Determination of liquid and gaseous fuel calorific value using Boy's gas Calorimeter
6. Valve timing diagram for I C Engine.
7. Measurement of an irregular area using Planimeter

PART B
List of Experiment

1. Two stroke Petrol engine test rig (Mechanical loading)
2. Two stroke Petrol engine test rig (Electrical loading)
3. Computerized Four stroke Petrol engine test rig
4. Computerized Four stroke Diesel (VCR) engine test rig
5. Multi cylinder petrol engine – Morse Test
6. Performance testing of a 2 stage reciprocating Air Compressor
7. Performance testing of Centrifugal Blower

Students are required to do experiments individually from Part A and in a group of 4 to 5 students from Part B

Text Books:

1. Applied Thermodynamics Manual, Department of Mechanical Engineering, MSRIT

Reference Books:

1. Basic and Applied Thermodynamics by P K Nag, Tata-Mc-Graw Hill publications, 2008
2. Applied thermodynamics, Kestoor Praveen, SUGGi Publishing, 2014

Web links and video lectures (e-Resources):

1. https://www.youtube.com/watch?v=2ths8kOkqPU
2. https://www.youtube.com/watch?v=SHdESVROvVs
3. https://www.youtube.com/watch?v=30-FdRgygI0
4. https://www.youtube.com/watch?v=H_RgFXjg-5s
5. https://www.youtube.com/watch?v=1_Jw6XUScvo

Course Outcomes (COs):

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

1. Determine properties such as flash and fire point, viscosity and calorific value of various types of fuels. (PO1, 2, 4) (PSO1, 2)
2. Demonstrate the use of Valve timing diagram of IC Engines and use of Planimeter (PO1, 2, 3, 4) (PSO1, 2)
3. Conduct experiments on I C Engines, Blowers and Air compressors to determine performance parameters (PO1, 2, 3, 4, 6) (PSO1, 2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Weekly evaluation of laboratory records after the conduction of every experiment	30	CO1,CO2 & CO3
Laboratory test	10	CO1,CO2 & CO3
Viva-voce	10	CO1,CO2 & CO3
Semester End Examination (SEE): 100 Marks		
Semester End Examination	50	CO1,CO2 & CO3

MECHANICAL MEAUREMENTS AND METROLOGY LAB	
Course Code: MEL48	**Credits: 0:0:1**
Pre – requisites: Nil	**Contact Hours: 30P**
Course Coordinator: Dr. Nagesh S N	

Course Content

PART-A

List of Experiments.

1. Calibration of pressure transducer
2. Calibration of thermocouple
3. Calibration of LVDT
4. Determination of material constants, E & G.
5. Calibration of stroboscope
6. Calibration of micrometer using slip gauges
7. Double flank test using gear roll tester
8. Determination of gear tooth profile using gear tooth tester
9. Measurement of tool-tip temperature
10. Digimatic miniprocessor

PART-B

List of experiments

1. Measurements using tool makers microscope
2. Measurements using profile projector
3. Measurement of angles using sine center, sine bar and bevel protractor
4. Determination form tolerance of a ground product using pneumatic comparators
5. Drawing of Merchant's circle diagram
6. Determination of screw thread parameters using floating carriage diameter measuring machine.
7. Measurement of alignment using autocollimator

- Pedagogy/Course delivery tools: Chalk and Talk, laboratory Manuals,
- Links: https://www.youtube.com/watch?v=up-itS3jefQ
  https://www.youtube.com/watch?v=DC5u_SvO8r4
  https://www.youtube.com/watch?v=qwhc2pGco_Y
  https://www.youtube.com/watch?v=kMFZfH-8DeQ
  https://www.youtube.com/watch?v=MdCifxRSzMk
  https://www.youtube.com/watch?v=3CFXzctvHAo
  https://www.youtube.com/watch?v=moFETpF7Ezo

Text Books:

1. Mechanical measurements, by Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Engineering Metrology, by R.K.Jain, Khanna Publishers, 1st edition 1994.

Reference Books:

1. Engineering Metrology, by I.C.Gupts, Dhanpat Rai Publications, Delhi. 2nd edition 2006 edition.
2. Mechanical measurements, by R.K.Jain. 5th edition 2006.
3. Industrial Instrumentation, Alsutko, Jerry.D.Faulk, Thompson Asia Pvt. Ltd.1st edition 2002.
4. Measurements Systems Applications and Design, by Ernest O. Doblin, McGraw Hill Book Co.2nd edition. 2006

Course outcomes:

After successful completion of this course, students will be able to

11. Apply calibration technique to various measuring device to standardize the instruments. (PO1,2,4,11) (PS01&2)
12. Demonstrate usability of different measuring instruments to measure various parameters applicable in mechanical engineering. (PO1,2,4,11) (PS01&2)
13. Investigate the applicability of standard measuring devices. (PO1,2,4,11) (PS01&2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Weekly evaluation of laboratory records after the conduction of every experiment	30	CO1, CO2 & CO3
Laboratory test	15	CO1, CO2 & CO3
Viva-voce	5	CO1, CO2 & CO3
Semester End Examination (SEE): 100 Marks		
Semester End Examination	50	CO1, CO2 & CO3

MANUFACTURING PROCESS LABORATORY	
Course Code: MEL49	**Credits: 0:0:1**
Pre – requisites: Nil	**Contact Hours: 30P**
Course Coordinator: Dr. Mohandas K N	

Course Content

PART A

Conduction of the following experiments:

1. **Casting:** Preparing mold cavity, melting and pouring of molten metal and finishing the cast metal.
2. **Forging:** Forging the given workpiece to required shape and dimension and then subjecting the same workpiece to heat treatment (Quenching - water, oil, air, etc.)

Pedagogy/Course delivery tools	Chalk and talk, Power-point presentation, animated videos
Lab Component / Practical Topics	Foundry models and forging exercises
Links	https://www.youtube.com/watch?v=PkjpmPLNKZs
Links	https://www.youtube.com/watch?v=j-xk2FvcAz4

PART B

Conduction the following experiments:

1. **Lathe:** Step turning, thread cutting (V-thread, Square thread, left hand and Right hand threads) and Eccentric turning.
2. **Simple model preparation using CNC Turning Centre (Demonstration) :** Facing, Plain Turning, Step Turning
3. **Milling Machine:** Indexing, cutting of gear tooth (Spur gear, Helical gear), face milling and grooving.
4. **Shaping Machine:** Cutting of V groove and Dovetail.

Pedagogy/Course delivery tools	Chalk and talk, Power-point presentation, animated videos
Lab Component / Practical Topics	Subassemblies in Machines at Machine Shop
Links	https://www.youtube.com/watch?v=xarj36BpiB4
Links	https://www.youtube.com/watch?v=Bc0wZLVKI6U
Links	https://www.youtube.com/watch?v=hCh2_d5hcqs

Reference Books:

1. Serope Kalpakjian, Joyjeet Ghose, Steven R. Schmid "Manufacturing Processes for Engineering Materials" Sixth Edition, Pearson Publication, 2018.
2. Manufacturing Process laboratory manual, Department of Mechanical Engineering, RIT.

Video Links:

1. https://www.youtube.com/watch?v=x1N1mpxGB0Y
2. https://www.youtube.com/watch?v=ZhCmhzC6PyI
3. https://www.youtube.com/watch?v=_viYnlfXAEA
4. https://www.youtube.com/watch?v=XTU0Z-FkhtU
5. https://www.youtube.com/watch?v=6jQ4y0LK1kY
6. https://www.youtube.com/watch?v=c8M_xYOceLg
7. https://www.youtube.com/watch?v=xarj36BpiB4

9. https://www.youtube.com/watch?v=Bc0wZLVKI6U
10. https://www.youtube.com/watch?v=Gun5Kr-lmls
11. https://www.youtube.com/watch?v=7tN_uGHNknM
12. https://www.youtube.com/watch?v=qxBTSUtKl1M

Course Outcomes (COs):

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

1. Acquire the skill to create foundry models and forging models based on dimensions and select the appropriate heat treatment methods for the forged components. (P01,2,48,9,11) (PS01&2)
2. Demonstrate the skill developed in preparing models using different operations on lathe. (P01,2,3,4,6,8,9,11) (PS01&2)
3. Demonstrate the skill developed in preparing models using different operations on milling machine, shaping machine and surface grinding machine. (P01,2,3,4,6,8,9,11) (PS01&2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Weekly evaluation of laboratory records after conduction of every experiment	30	CO1, CO2 and CO3
Laboratory Test	10	CO1, CO2 and CO3
Viva-voce	10	CO1, CO2 and CO3
Semester End Examination (SEE): 50 Marks		
Semester End Examination	50	CO1, CO2 and CO3

INTER/ INTRA INSTITUTIONAL INTERNSHIP	
Course Code: INT410	**Credits: NCMC**
Pre – requisites: Nil	
Course Coordinator: -Mr. DEEPAK S AND Dr. RAJENDRA P	

Course Content

All the students shall have to undergo a mandatory Internship of 02 weeks which is an NCMC course, during the intervening vacation of the II and III semesters. Internship shall include Intra Institutional activities across the institute. A student shall select an internship of his/her choice and attend for 02 weeks. An internal evaluation of the same will be conducted by the internship organizing department and marks scored will be sent to the parent department. A student shall register for the internship in IV semester and shall complete the internship requirements.

All the students admitted under the lateral entry category shall have to undergo this Internship of 02 weeks which is an NCMC course, during the intervening vacation of the III and IV semesters.

III Semester

(For Lateral Entry Diploma Students)

ADDITIONAL MATHEMATICS – I	
Course Code: AM31	**Credits: 0:0:0**
Pre – requisites: Nil	**Contact Hours: 45L**
Course Coordinator: Dr. Shashi Prabha Gogate S	

Course Content

Unit I

Differential Calculus: Successive differentiation, nth derivatives of some standard functions, Leibnitz theorem, Polar curves. Angle between the radius vector and the tangent, angle between curves, length of the perpendicular from pole to the tangent, pedal equations. Taylor's and Maclaurin's expansions.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

Unit II

Integral Calculus: Introduction, Reduction formula, Reduction formula for $\int Sin^n x\ dx$, $\int Cos^n x\ dx$ and $\int Sin^n x\ Cos^m\ x\ dx$. Evaluation of double and triple integrals.

- Pedagogy / Course delivery tools: Chalk and talk
- Links https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

Unit III

Vector Algebra: Scalar and vectors. Vector addition and subtraction. Multiplication of vectors (Dot and Cross products). Scalar and vector triple product-simple problems. Vector functions of a single variable. Derivative of a vector function, geometrical interpretation. Velocity and acceleration.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105134
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

Unit IV

Vector Differentiation: Scalar and vector fields, gradient of a scalar field, directional derivative, divergence of a vector field, solenoidal vector, curl of a vector field, irrotational vector. Laplace's operator. Vector identities connected with gradient, divergence and curl.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105134
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

Unit V

First Order Differential Equations: Solution of first order and first degree differential equations, variable separable methods, homogeneous equations, linear and Bernoulli's equations, exact differential equations.

- Pedagogy / Course delivery tools: Chalk and talk, Power Point Presentation
- Links: https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/59742/295

Text Books:

1. **B.S. Grewal** – Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2. **Erwin Kreyszig** – Advanced Engineering Mathematics – Wiley Publication, 10th Edition, 2015.

Reference Books:

1. H. K. Dass – Higher Engineering Mathematics – S Chand Publications, 1998.
2. B. V. Ramana – Engineering Mathematics – Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008.

Course Outcomes (COs):

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

1. Solve problems related to nth derivative to some standard functions, polar curves and power series expansions. (PO-1,2)
2. Apply the concept of reduction formula to determine the length, area, volume of revolution of an arc of the curve. (PO-1,2)
3. Solve the problems related to velocity and acceleration. (PO-1,2)
4. Apply vector differentiation to identify solenoidal and irrotational vectors. (PO-1,2)
5. Apply the concept of various methods to solve first order first degree differential equations. (PO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components(20)		
Assignment	10	CO1,CO2,CO3 CO4,CO5
Surprise test	10	CO1,CO2,CO3 CO4,CO5

IV Semester
(For Lateral Entry Diploma Students)

ADDITIONAL MATHEMATICS – II	
Course Code: AM41	**Credits: 0:0:0**
Pre – requisites: Nil	**Contact Hours: 45L**
Course Coordinator: Dr. VEENA B N	

Course Content

Unit I

Differential Calculus- I: Partial differentiation, Euler's theorem, total differential coefficient, differentiation of composite and implicit functions.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

Unit II

Differential Calculus- II: Jacobian and Properties. Taylor's theorem for function of two variables, maxima and minima for functions of two variables.

- Pedagogy / Course delivery tools: Chalk and talk
- Links https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030
- https://a.impartus.com/ilc/#/course/59742/295

Unit III

Vector Integration: Line integrals, surface integrals and volume integrals. Green's theorem, Stokes' and Gauss divergence theorem (without proof) and problems, orthogonal curvilinear coordinates.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105134/
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

Unit IV

- **Higher Order Differential Equations**: Higher order linear differential equations, method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations.
- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/96127/452
- https://a.impartus.com/ilc/#/course/59742/295

Unit V

Probability: Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems, Conditional probability- illustrative examples. Bayes theorem – examples.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/107/111107119/
- Impartus recording: https://a.impartus.com/ilc/#/course/283623/703

Text Books:

1. **B.S. Grewal** – Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2. **Erwin Kreyszig** – Advanced Engineering Mathematics – Wiley Publication, 10th Edition, 2015.

Reference Books:

1. **H. K. Dass** – Higher Engineering Mathematics – S Chand Publications, 1998
2. **B. V. Ramana** – Engineering Mathematics – Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008.

Course Outcomes (COs):

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

1. To carryout differentiation of function of several variables. (PO-1,2)
2. Solve the problems related to Jacobians, the extreme values of a function and Taylors series. (PO-1,2)
3. Exhibit the interdependence of line, surface and volume integrals using integral theorems. (PO-1,2)
4. Find the solution of second and higher order ODEs with constant and variable coefficients. (PO-1,2)
5. Solve the problems on conditional probability and Baye's theorem. (PO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components		
Assignment	10	CO1,CO2,CO3 CO4,CO5
Surprise test	10	CO1,CO2,CO3 CO4,CO5