SRI MANAKULA VINAYAGAR

ENGINEERING COLLEGE

(An Autonomous Institution)
Puducherry

2nd Board of Studies Meeting in the
Department of Mechanical Engineering

for the Programmes
B.Tech, M.Tech & Ph.D

Date & Time
10-04-2021 & 10.30 am

MINUTES OF THE MEETING

Department of Mechanical Engineering

Minutes of Board of Studies Meeting (UG)

The SecondBoard of Studies meeting of Department of Mechanical Engineering was held on 10 April 2021 at 10:30 A.M in the R&D Lab, Department of Mechanical Engineering, Sri Manakula Vinayagar Engineering College with the Head of the Department in the Chair.

The following members were present for the BoS meeting:

Sl. No	Name of the Member with Designation and official Address	Responsibility in the BoS
1	Dr. K.Velmurugan Professor and Head Department of MECH, SMVEC	Chairman
External Members		
2	Dr. N. Alagumurthi, Ph.D, Professor & Head Department of Mechanical Engineering, Pondicherry Engineering College, Puducherry-605014. Email id: alagumurthi@pec.edu Mobile No.: 9486143090	University Nominee
3	Dr. M. Leenus Jesu Martin, Ph.D, Director for campus SRM Institute of Science and Technology, Tamil Nadu – 603203 Email id: hod.auto@ktr.srmuniv.ac.in Mobile No.: 9940036021	Member
4	Dr. A.T. Ravichandran, Ph.D, Dean School of Mechanical and Construction Engineering Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology, Avadi, Chennai – 600062 Email id: hodmech@veltech.edu.in Mobile No.: 9942940600	Member
Internal Members		
5	Dr.G.G.Sozhamannan, Professor, **Specialization:** ***Manufacturing Engineering***	Member
6	Dr.T.Coumaressin, Associate Professor, **Specialization:** ***Thermal Engineering***	Member

7	Dr.K.Hemalatha, Associate Professor, **Specialization:** ***Engineering Design***	Member
8	Dr.A.Thiagarajan, Associate Professor, **Specialization:** ***Product Design & Manufacturing***	Member
9	Prof.N.Vijayan, Assistant Professor, **Specialization:** ***Mathematics***	Member
10	Prof.K.Oudayakumar Associate Professor, **Specialization:** ***Physics***	Member
11	Dr.K.Karthikeyan Associate Professor, **Specialization:** ***Chemistry***	Member
12	Dr.D.Jaichithra, Professor, **Specialization:** ***English***	Member
Co-opted Members		
13	Dr. Anand Gurupatham Deputy General Manager, CAE-Department Head at Renault Nissan, Technology & Business Center, Chennai, Tamil Nadu, India	Industrial Member
Alumni		
14	Mr.P.Madavan, Research Scholar MIT, Anna university, Chennai.	Alumni Member

Agenda of the Meeting

1. Consideration of confirmation of minutes of the previous meeting held on 17.07.2020
2. Consideration of revision of curriculum and syllabus of V and VI semester of
   - B.Tech. MECHANICAL to be offered under Regulations 2019 to the students admitted in the academic year 2019-20
3. Consideration of revision of curriculum and syllabus of III and IV semester of
   - B.Tech. MECHANICAL to be offered under Regulations 2020 to the students admitted in the academic year 2020-21
     a. Revision of detail syllabus
     b. Revision of list of electives to be offered in both the semesters
4. Consideration of assessment of quality of question papers of U.G. Programmes drawn in previous examinations
5. Consideration of review of feedback received from various stakeholders like parents, alumni, Industries Experts, Recruiters etc.on the revised Vision, Mission and Program Educational Objectives (PEOs) of the Department
6. Consideration of offering of Professional and Open electives in IV semester students admitted in the Academic Year 2019-20. The students should have to register one professional and one open elective as per Regulations 2019.

7. To consider and approve the department committee to monitor the Academic Activities
8. Consideration and approve the students admitted in the Academic Year 2020-21
9. Discuss about immediate supplementary exam for 2017-2021 batch after the VIII semester end semester examination results declaration due to Covid situation
10. Consideration of revision of list of panel of question paper setters and Examiners for the examinations of UG Programmes for the academic year 2021-22
11. Any other item with the permission of chair

UG Minutes of the Meeting

Dr. K.Velmurugan, Chairman, BoS opened the meeting by welcoming and introducing the external members, to the internal and co-opted members and thanked them for accepting to become the member of the Board of Studies and the meeting thereafter deliberated on agenda items that had been approved by the Chairman.

Item:1

Consideration of confirmation of minutes of the previous meeting held on 17.07.2020:

Chairman, BoS, appraised the minutes of Ist BoS, its implementation and then it is confirmed with the approval for the incorporation of minor revisions needed as mentioned below:

Sl. No.	Points discussed	Annexure
1.	Curriculum 2019-2020, 191 credit is very high • Credits reduced from 191 to 164 for the Curriculum and Regulation 2020-21 • Credits reduced from 191 to 182 for the Curriculum and Regulation 2019-20	**1.1**
2.	Certain subjects can be clubbed and modern subjects can be included • Latest technology subjects are included in the electives	**1.2**
3.	Fundamental of Mechanical Engineering can be removed for Mechanical Students as they are studying it as their domain • Fundamental of Mechanical Engineering removed from curriculum	**1.3**
4.	Basic Science papers can be added in I semester • Physics for Mechanical Engineering included in I semester	**1.4**
5.	Syllabus should be based on Outcome based, mapping to be provided in the syllabus • Syllabus are prepared based on OBE, mapping provided	**1.5**
6.	Blooms Taxonomy knowledge levels should be given for the questions when setting the question papers • Blooms Taxonomy knowledge levels included in question papers	**1.6**
7.	Engineering Metallurgy: Unit 3 Casting process can be removed in that place controlling factors of casting metallurgy must be included In Engineering Metallurgy, Unit 3 Casting process removed as per the suggestions	**1.7**
8	Subjects and lab concepts should go parallel • Subjects and lab are planned accordingly	**-**
9	Mandatory courses like Indian constitution, Essence of Indian Traditional Knowledge, Professional ethics, Induction program should be made compulsory for all students • Mandatory courses like Indian constitution, Essence of Indian Traditional Knowledge, Professional ethics, Induction program made mandatory	**1.9**

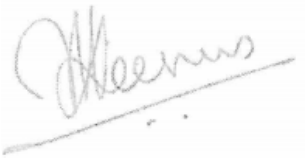
Item:2	**Recommended to approve** the B.Tech. Degree Regulations 2019 (R-19), Curriculum from I to VIII semesters and syllabus for V and VI the B.Tech – Mechanical Engineering for the students going to be admitted in the Academic Year 2019-20 with few suggestion: **(Annexure 2)** 1. In the 2019 Regulation, the **professional elective subject Hydrogen fuel** can be replaced with courses like **Electric vehicles** or **Mass Rapid Transport System** (MRTS), this will enhance the student's knowledge on Railways thus enabling them to pursue their career in Railways **(Annexure 2.1)** 2. In the laboratories, **skill levels** (S1, S2, S3) can be added in addition to knowledge level 3. IPR, copy rights, trade and patent making concepts to be included in syllabus 4. Analytical subjects should have 60 hours, each tutorial hour should be awarded 1 credit
Item:3	**Recommended to approve** the B.Tech. Degree Regulations 2020 (R-2020), Curriculum from I to VIII semesters and syllabus for III to IV B.Tech – Mechanical Engineering for the students admitted in the Academic Year 2020-21 with minor correction **(Annexure 3)** 1. In the **Basic Electrical & Electronics Engineering Course** of I semester, Knowledge level k4 is used which indicates End semester question paper should also attain that level, which will be too high for I year students. 2. A course on Universal **human values** to be made mandatory 3. While organizing **Induction program** for I year students, technical games related to other department can also be conducted to provoke students' inter-disciplinary subject interest 4. The experts feel **too many labs are available**, instead integrated courses (Theory lab) combined can be floated, this will improve student's technical skill on that particular course 5. **MOOC** (Massive Open Online Courses) like NPTEL courses can be made creditable. List of approved courses can be finalized by the department committee. The students have to produce his course completion certificate for claiming credits. If he/she fails, the student should take up the similar type of assessment conducted by the institute for the claim of the credit 6. The MOOC can even be included in professional elective; instead of studying a subject student can do a course in NPTEL. This will benefit students by receiving certificate from IITs. This will provoke self-learning skills among students 7. While floating electives, instead of offering to selective department, electives subjects should be selected in such a way that it can be offered to all department 8. The course codes of open elective -II offered by MBA department can be made same to avoid confusion in COE

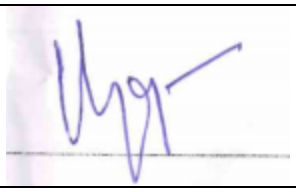
Item:3	9. The syllabus content of the courses should also be practiced in the lab, to gain practical knowledge. For subjects like Industrial Casting Technology, demonstration using casting furnace, Foundry practice can be given as either group exercise or lab technician can demonstrate 10. Subject like **Design for Manufacturing** can be included 11. K1 level can be taken out from course outcomes, as it denotes very low basic level, which the students expected to acquire during their schooling. 12. In the Course **Non-conventional energy sources,** unit IV to be renamed as Geothermal & Bio-Mass Sources **(Annexure 3.12)** 13. **Hydraulics and Pneumatics subject** to be included as Core subject, since students should possess the knowledge on values, actuators which will help to pursue career in industrial automation 14. New subjects and labs like **Mechanical equipments for infrastructure, Core Engineering Industries, Material handling equipment, Energy auditing, Industrial coding, Industrial safety lab, Low energy consuming equipments** can be added to enhance students core engineering knowledge and exposure 15. In the course **IoT & Smart Manufacturing**, unit III content to be modified **(Annexure 3.15)** 16. In the course Energy & Climate Change, **Unit V Alternate Fuels and Renewable Energy** need to be changed, to avoid content repetition **(Annexure 3.16)** 17. In the Employability Enhancement course AutoCAD for Mechanical title to be reframed as AutoCAD for Mechanical Engineering 18. In the Employability Enhancement courses, Trouble and Troubleshooting to be replaced as Trouble shooting and repair of two-wheeler, Trouble shooting and repair of four-wheeler, Trouble shooting and repair of CNC machines, Electronic Trouble shooting for Mechanical Engineering 19. In the EEC, Hands on training using 3D printing can be replaced just as 3D printing
Item:4	Consideration of assessment of quality of question papers of U.G. Programmes drawn in previous examinations • The BOS experts reviewed the End semester question papers of the III, V and VII semester Autonomous exams and found satisfactory
Item:5	Consideration of review of feedback received from various stakeholders like parents, alumni, Industries Experts, Recruiters etc. on the revised Vision, Mission and Program Educational Objectives (PEOs) of the Department **(Annexure 5)** • The BOS experts reviewed the revised Vision, Mission and Program Educational Objectives (PEOs) of the Department and suggested PSO to be made as program/domain specific

Item:6	Consideration of offering of Professional and Open electives in IV semester students admitted in the Academic Year 2019-20. The students should have to register one professional and one open elective as per Regulations 2019. • The committee approved the list of professional and open elective offered by the departments for the IV semester students admitted in Academic year 2019-2020 • The students willingness to opt elective has been collected and the following electives were selected by students **Professional Electives** 1. U19MEE42/Computer Aided design 2. U19MEE43/Product design and development 3. U19MEE45/Non-conventional energy sources **Open elective** 1. U19CS043/ Programming in JAVA
Item:7	To consider and approve the department committee to monitor the Academic Activities • The BOS experts recommended to include Course Equivalence Committee, in the committee list for the redo candidates of different regulations
Item:8	To Consider and approve the students admitted in the Academic Year 2020-21 • For **BSc students admission** into B.Tech program as lateral entry, the students need to undergo bridge course with assessment (or) BSc students eligibility can be declined for B.Tech Lateral admission • Diploma lateral entry - more courses to be added as per TNEA /CENTAC / PTU revised guidelines **(Annexure 8)**
Item:9	Discuss about immediate supplementary exam for 2017-2021 batch after the VIII semester end semester examination results declaration due to Covid situation • The BOS experts recommended and passed to the Academic council and Governing Body
Item:10	• Consideration of revision of list of panel of question paper setters and Examiners for the examinations of UG Programmes for the academic year 2021-22 • Recommended to approve the panel of examiners (**Annexure 10**)

Item:11	**Other points Discussed** 1. Overall the committee experts were satisfied with our curriculum structure and syllabus framing 2. Curriculum design to be done every year. At the end of every semester feedbacks to be collected from faculties and students related to depth of knowledge, whether time span is sufficient to complete the syllabus, or any other advanced topics to be included. This has to be recorded in the internal BOS in concurrence with the course coordinator and forwarded to BOS for further approval. 3. The current syllabus for the curriculum 2019-20 and 2020-21 are approved without any further revision, except for the few mentioned course little flaws to be rectified 4. IPR, Geographical Indicators, Copy rights such subjects can also be incorporated 5. Credits can be given for patent and journal publication by students 6. In the open elective Patent/Journal can be considered 7. Value added courses on energy auditing, industrial safety can be conducted through industry interaction and students can be certified, which will be an added advantage for their jobs 8. Japanese can be included in the foreign language classes. As the students with Japanese proficiency find more opportunities in Japan 9. Engineering Product Lab: The purpose of the lab is to check the working, repair and maintenance work of Washing machine, Grinder, Iron Box and other house hold equipment 10. Course coordinator committee meeting along with students representatives to be conducted at the end of the semester, to discuss about the discrepancies faced like depth of syllabus, hours allotted for completing the syllabus and students feedbacks related to the curriculum and the subjects

The meeting was concluded at 01:30PM with vote of thanks by Dr.K.Velmurugan, Head of Department, Mechanical Engineering

Sl. No	Name of the Member with Designation and official Address	Responsibility in the BoS	Signature
1	Dr. K.Velmurugan Professor and Head Department of MECH, SMVEC	Chairman	
External Members			
2	Dr. N. Alagumurthi, Ph.D, Professor & Head Department of Mechanical Engineering, Pondicherry Engineering College, Puducherry-605014. Email id: alagumurthi@pec.edu Mobile No.: 9486143090	University Nominee	
3	Dr. M. Leenus Jesu Martin, Ph.D, Director for campus SRM Institute of Science and Technology, Tamil Nadu – 603203 Email id: hod.auto@ktr.srmuniv.ac.in Mobile No.: 9940036021	Member	
4	Dr. A.T. Ravichandran, Ph.D, Dean School of Mechanical and Construction Engineering Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology, Avadi, Chennai – 600062 Email id: hodmech@veltech.edu.in Mobile No.: 9942940600	Member	
Internal Members			
5	Dr.G.G.Sozhamannan, Professor, **Specialization:** ***Manufacturing Engineering***	Member	
6	Dr.T.Coumaressin, Associate Professor, **Specialization:** ***Thermal Engineering***	Member	
7	Dr.K.Hemalatha, Associate Professor, **Specialization:** ***Engineering Design***	Member	
8	Dr.A.Thiagarajan, Associate Professor, **Specialization:** ***Product Design & Manufacturing***	Member	

9	Prof.N.Vijayan, Assistant Professor, **Specialization: *Mathematics***	Member	
10	Prof.K.Oudayakumar Associate Professor, **Specialization: *Physics***	Member	
11	Dr.K.Karthikeyan Associate Professor, **Specialization: *Chemistry***	Member	
12	Dr.D.Jaichithra, Professor, **Specialization: *English***	Member	
Co-opted Members			
13	Dr. Anand Gurupatham Deputy General Manager, CAE-Department Head at Renault Nissan, Technology & Business Center, Chennai, Tamil Nadu, India	Industrial Member	
Alumni			
14	Mr.P.Madavan, Research Scholar MIT, Anna university, Chennai.	Alumni Member	

Annexure1.1

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

Sl. No	Course Category	Breakdown of Credits
1	Humanities and Social Science (HS)	09
2	Basic Sciences(BS)	40
3	Engineering Sciences (ES)	30
4	Professional Core (PC)	65
5	Professional Electives (PE)	18
6	Open Electives (OE)	09
7	Project Work and Internship (PW)	12
8	Employability Enhancement Courses (EEC*)	-
9	Mandatory courses (MC*)	-
Total		**183**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl. No	AICTE Suggested Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences (HS)	-	4	-	-	-	3	1	1	9
2	Basic Sciences (BS)	14	16	3	3	4	-	-	-	40
3	Engineering Sciences (ES)	16	10	4	-	-	-	-	-	30
4	Professional Core (PC)	-	-	14	12	12	15	9	3	65
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	3	3	-	3	-	9
7	Project Work (PW)	-	-	-	-	-	-	2	8	10
8	Internship (PW)	-	-	-	-	-	-	2	-	02
9	Employability Enhancement Courses (EEC*)	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC*)	-	-	-	-	-	-	-	-	-
Total		**30**	**30**	**21**	**21**	**22**	**21**	**20**	**18**	**183**

**** EEC and MC credits are not included for CGPA calculation***

Annexure1.2

OPEN ELECTIVE COURSES

Sl. No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)				
1	U19EEO41	Solar Photovoltaic Fundamentals and Applications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics
2	U19EEO42	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, BME, IT, CSE
3	U19ECO41	Engineering Computation with MATLAB	ECE	ICE, EEE, MECH, CIVIL, BME, Mechatronics
4	U19ECO42	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics
5	U19CSO41	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U19CSO42	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U19CSO43	Programming in JAVA	CSE	ECE, MECH, Mechatronics
8	U19ITO41	Database System: Design & Development	IT	EEE, ECE, ICE, BME
9	U19ITO42	R programming	IT	EEE, ECE, ICE, BME, MECH, Mechatronics
10	U19ICO41	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL
11	U19ICO42	Control System Engineering	ICE	CSE, IT, MECH
12	U19MEO41	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME
13	U19MEO42	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
14	U19MEO43	Power Plants for Electrical Engineering	MECH	EEE
15	U19CEO41	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics
16	U19CEO42	Building Science and Engineering	CIVIL	EEE, MECH, BME
17	U19BMO41	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
18	U19BMO42	Telemedicine	BME	EEE, ECE, CSE, IT, ICE
19	U19CCO41	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U19CCO42	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics

Open Elective – II / Open Elective – III				
1	U19HSO51 / U19HSO61	Product Development and Design	MBA	**Common to B. Tech** (Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME**) (Offered in Semester VI for **CSE, IT, MECH, Mechatronics**)
2	U19HSO52 / U19HSO62	Intellectual Property and Rights	MBA	
3	U19HSO53 / U19HSO63	Marketing Management and Research	MBA	
4	U19HSO54 / U19HSO64	Project Management for Engineers	MBA	
5	U19HSO55 / U19HSO65	Finance for Engineers	MBA	
Open Elective – II / Open Elective – III (Offered in Semester V for **CSE, IT, MECH, Mechatronics**) (Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME**)				
1	U19EEO53 / U19EEO63	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
2	U19EEO54 / U19EEO64	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics
3	U19ECO53 / U19ECO63	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE MECH, BME, Mechatronics
4	U19ECO54 / U19ECO64	Automotive Electronics	ECE	EEE, ECE, ICE, MECH
5	U19CSO54 / U19CSO64	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
6	U19CSO55 / U19CSO65	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
7	U19ITO53 / U19ITO63	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME
8	U19ITO54 / U19ITO64	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
9	U19ITO55 / U19ITO65	Data Structures	IT	MECH
10	U19ICO53 / U19ICO63	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME
11	U19ICO54 / U19ICO64	Measurement and Instrumentation	ICE	ECE, Mechatronics
12	U19MEO54 / U19MEO64	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
13	U19MEO55 / U19MEO65	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics

14	U19CEO53 / U19CEO63	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
15	U19CEO54 / U19CEO64	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
16	U19BMO53 / U19BMO63	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
17	U19BMO54 / U19BMO64	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, MECH, CIVIL , Mechatronics
18	U19CCO53 / U19CCO63	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
19	U19CCO54 / U19CCO64	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U19ADO51 / U19ADO61	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL
21	U19ADO52 / U19ADO62	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics
Open Elective – IV (Offered in Semester VII)				
1	U19EEO75	Hybrid and Electrical Vehicle	EEE	ECE, Mechatronics , MECH
2	U19EEO76	Electrical Energy Conservation and auditing	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
3	U19ECO75	IoT and its Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL
4	U19ECO76	Cellular and Mobile Communications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics
5	U19CSO76	Artificial Intelligence	CSE	EEE, ICE, CIVIL, MECH
6	U19CSO77	Cloud Technology and its Applications	CSE	EEE, ICE, MECH, CIVIL, BME, Mechatronics
7	U19ITO76	Automation Techniques & Tools- DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, BME, Mechatronics
8	U19ITO77	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, BME
9	U19ICO75	Process Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, BME, Mechatronics.
10	U19ICO76	Virtual Instrumentation	ICE	EEE, ECE, MECH, Mechatronics
11	U19MEO76	Principles of Hydraulic and Pneumatic System	MECH	EEE, ECE, ICE, CIVIL
12	U19MEO77	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics
13	U19CEO75	Energy Efficient Buildings	CIVIL	EEE, ECE, MECH
14	U19CEO76	Global Warming and Climate	CIVIL	EEE, ECE, CSE, IT, ICE, MECH,

		Change		BME
15	U19MCO71	Building Automation	Mechatronics	MECH, CIVIL
16	U19MCO72	Automation in Manufacturing Systems	Mechatronics	MECH, CIVIL
17	U19BMO75	Internet of Things for Healthcare	BME	EEE, ECE, ICE
18	U19BMO76	Telehealth Technology	BME	EEE, ECE, ICE
19	U19CCO75	Data Science using python	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME,
20	U19CCO76	Mobile Applications Development using Android	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME,
21	U19ADO73	Data Science Application of NLP	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics
22	U19ADO74	Artificial Intelligence Applications	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME

Annexure1.3

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	T101	Mathematics– I	BS	3	1	0	4	25	75	100
2	T102	Physics	BS	4	0	0	4	25	75	100
3	T103	Chemistry	BS	4	0	0	4	25	75	100
4	T104	Basic Electrical and Electronics Engineering	ES	3	1	0	4	25	75	100
5	T105	Engineering Thermodynamics	ES	3	1	0	4	25	75	100
6	T106	Computer Programming	ES	3	1	0	4	25	75	100
Practical										
7	P101	Computer Programming Lab	ES	0	0	3	2	50	50	100
8	P102	Engineering Graphics	ES	2	0	3	2	50	50	100
9	P103	Basic Electrical and Electronics Lab	ES	0	0	3	2	50	50	100
							30	300	600	900

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	T107	Mathematics–II	BS	3	1	0	4	25	75	100
2	T108	Material Science	BS	4	0	0	4	25	75	100
3	T109	Environmental Science	BS	4	0	0	4	25	75	100
4	T110	Basic Civil and Mechanical Engineering	ES	4	0	0	4	25	75	100
5	T111	Engineering Mechanics	ES	3	1	0	4	25	75	100
6	T112	Communicative English	HS	4	0	0	4	25	75	100
Practical										
7	P104	Physics Laboratory	BS	0	0	3	2	50	50	100
8	P105	Chemistry Laboratory	BS	0	0	3	2	50	50	100
9	P106	Workshop Practice	ES	0	0	3	2	50	50	100
Mandatory Course										
10	P107	NSS/NCC*	MC	0	0	0	-	-	-	-
							30	300	600	900

**** To be completed in I and II semesters, under Pass / Fail option only and not counted for CGPA calculation***

Annexure1.4

U20BST106	PHYSICS FOR MECHANICAL ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- The purpose of this course is to provide an understanding of physical concepts and underlying various engineering and technological applications.
- In addition, the course is expected to develop scientific temperament and analytical skill in students, to enable them logically tackle complex engineering problems in their chosen area of application.
- This course gives good broad baseline knowledge of laser safety and fiber optics
- To acquire knowledge of the Quantum Mechanics in Classical Mechanics and electromagnetic radiation
- To understand the basis of solar energy and solar radiation measurement

Course Outcomes

After completion of the course, the students will be able to

CO1 - To understand the basic concept of semiconductor in physics. **(K2)**
CO2 - To apply the Physics concepts in acoustics. **(K3)**
CO3 - To understand scientifically the new developments in lasers and fiber optics. **(K3)**
CO4 - To understand about quantum mechanics and it applications. **(K2)**
CO5 - To emphasize the significance of Green technology through Physics principles. **(K1)**

UNIT I SEMICONDUCTOR PHYSICS (9 Hrs)

Semiconductor Physics: Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Carrier transport: Velocity-electric field relations – drift and diffusion transport - Einstein's relation – Hall effect and devices – Zener and avalanche breakdown in p-n junctions – tunnel diode - Schottky diode.

UNIT II ACOUSTICS (9 Hrs)

Acoustics: Intensity – Loudness – Absorption coefficient and its determination – Reverberation – Reverberation time – Factors affecting acoustics of buildings and their remedies – Sources and impacts of noise – Sound level meter – Strategies on controlling noise pollution – Ultrasonic waves and properties – Methods of Ultrasonic production (Magnetostriction and Piezoelectric) – Applications of Ultrasonic in Engineering and medicine.

UNIT III LASERS AND FIBER OPTICS (9 Hrs)

Lasers: Characteristics of Lasers – Einstein's coefficients and their relations – Lasing action – Working principle and components of CO2 Laser, Nd-YAG Laser, Semiconductor diode Laser, Excimer Laser and Free electron Laser – Applications in Remote sensing, holography and optical switching – Mechanism of Laser cooling and trapping.

Fiber Optics: Principle of Optical fiber – Acceptance angle and acceptance cone – Numerical aperture – V-number – Types of optical fibers (Material, Refractive index and mode) – Photonic crystal fibers – Fiber optic communication – Fiber optic sensors.

UNIT IV QUANTUM MECHANICS (9 Hrs)

Quantum mechanics: Inadequacies of Classical Mechanics – Duality nature of electromagnetic radiation – De Broglie hypothesis for matter waves –Heisenberg's uncertainty principle –Schrödinger's wave equation – Particle confinement in 1D box (Infinite Square well potential).

UNIT V GREEN ENERGY PHYSICS (9 Hrs)

Introduction to Green energy – Solar energy: Energy conversion by photovoltaic principle – Solar cells – Wind energy: Basic components and principle of wind energy conversion systems – Ocean energy: Wave energy – Wave energy conversion devices – Tidal energy – single and double basin tidal power plants – Ocean Thermal Electric Conversion (OTEC) – Geothermal energy: Geothermal sources (hydrothermal, geo-pressurized hot dry rocks, magma) – Biomass: Biomass and bio-fuels – bio-energies from wastages – Fuel cells: H2O2 – Futuristic Energy: Hydrogen – Methane Hydrates – Carbon capture and storage (CCS).

Text Books

1. J.D.Thiruvadigal, S.Ponnusamy, D.Sudha and M.Krishnamohan, “Physics for Technologists”, Vibrant Publication, Chennai, 2013
2. Dattu R.Joshi, “Engineering Physics”, Tata McGraw- Hill, New Delhi, 2010.
3. R.K Gaur. & Gupta,S.L, Engineering Physicsǁ. Dhanpat Rai Publishers, 2012.

Reference Books

1. Frank Fahy, “Foundations of Engineering Acoustics”, Elsevier Academic Press, 2005.
2. Alberto Sona, “Lasers and their applications”, Gordon and Breach Science Publishers Ltd., 1976.
3. Leonard. I. Schiff, “Quantum Mechanics”, Third Edition, Tata McGraw Hill, 2010.
4. Charles Kittel, "Introduction to Solid State Physics", Wiley India Pvt. Ltd, 7th ed., 2007.
5. Godfrey Boyle, “Renewable Energy: Power sustainable future”, 2nd edition, Oxford University Press, UK, 2004.

Web References

1. https://swayam.gov.in/nd1_noc20_ph15/preview
2. https://swayam.gov.in/nd1_noc20_ph22/preview
3. https://www.newport.com/t/fiber-optic-basics
4. http://www.greenenergytech.in/
5. https://nptel.ac.in/courses/112/104/112104026/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	1	1	-	1	-	1	-	2	-	1	1
2	3	2	1	1	-	1	-	-	1	1	-	2	2	1	1
3	3		1	-	1	1	-	1	1	1	-	1	1	1	1
4	3	1	1	-	-	1	-	-	-	1	-	1	1	-	1
5	3	1	-	-	1	2	2	1	1	1	1	2	1	1	1

Correlation Level: 1- Low, 2 - Medium, 3 – High

Annexure1.5

U20MET307	FLUID MECHANICS AND MACHINERY	L	T	P	C	Hrs
		2	2	0	3	45

Course Objectives

- To understand the properties of the fluid and flow characteristics.
- To emphasize the concept of dimensional analysis.
- To understand the concept of flow through circular pipes and boundary layer flows.
- To provide knowledge on the working principle and performance curves of hydraulic turbines.
- To educate the working principles and performance analysis of fluid pumps.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the basic fluid property and its application. **(K2)**
CO2 - To apply the concepts of dimensional analysis on the fluid structure. **(K3)**
CO3 - To solve the rate of flow and energy losses in flow through pipes. **(K3)**
CO4 - To evaluate the operating characteristics of hydraulic turbines. **(K3)**
CO5 - Understand the working principles of hydraulic pumps and performances **(K2)**

UNIT I FLUID PROPERTIES AND FLUID STATICS (9 Hrs)

Units and dimensions - Properties of fluids - mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension and capillarity, fluid statics, manometers, Hydrostatic Forces, buoyancy, forces on submerged bodies, stability of floating bodies

UNIT II FLUID KINEMATICS AND FLUID DYNAMICS (9 Hrs)

Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation. Bernoulli's equation, applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis -Buckingham's π theorem applications - similarity laws and models.

UNIT III INCOMPRESSIBLE FLUIDS AND FLOW THROUGH PIPES (9 Hrs)

Viscous flow - laminar flow between parallel plates, - Laminar and Turbulent flow, Reynold's experiment flow through Circular pipes - Darcy - Weisbach equation - friction factor minor losses – flow through pipes in series and in parallel - power transmission - boundary layer flows, boundary layer thickness, boundary layer separation.

UNIT IV HYDRAULIC MACHINE AND TURBINES (9 Hrs)

Principles of Turbo Machinery: Fluid Machines – Classification – Introduction to Impact of jet Stationary plates, Moving Plates and Vanes - Construction of Velocity Vector Diagram– Unit and Specific Quantities. Turbine - Classification – Impulse Turbine – Pelton Wheel – Reaction Turbines – Francis and Kaplan Turbines – Draft Tube Theory – Velocity Triangle – Estimation of force, Power and efficiency – General Characteristics of Turbine – Similarity Study – Governing of Turbine – Cavitation in Turbine.

UNIT V HYDRAULIC PUMPS (9 Hrs)

Classification - Centrifugal Pump – Velocity Triangle – Estimation of Power Required and efficiency – General characteristics - Similarity study – Cavitation in Pump – Reciprocating Pump – Air Vessels – Ideal and Actual Indicator Diagram – Estimation of Power Required, percentage Slip and Efficiency – Cavitation - special purpose pumps.

Text Books

1. R.K.Bansal, "Fluid Mechanics and Hydraulics Machines", Laxmi publications (P) Ltd., New Delhi, 10th Edition, 2018
2. V.L, Streeter and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 9thEdition, 2010.
3. K.L.Kumar, "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, 8thEdition, 2009.

Reference Books

1. S.S.Rattan - Fluid Mechanics and Hydraulic Machines- Khanna Publishers, 2019
2. S.M. Yahya, Turbine, Fans and Compressors, Tata McGraw-Hill- 4th Edition 2017.
3. Yunus Çengel, John M. Cimbala - Fluid Mechanics Fundamentals and Applications-Mc Graw Hill, 4th Edition, 2017
4. F.M.White, "Fluid Mechanics", Tata McGraw-Hill, New Delhi, 8th Edition, 2016.
5. P.N.Modi and S.M.Seth "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 20th Edition, 2015.

Web References

1. https://nptel.ac.in/courses/112/104/112104117/
2. https://nptel.ac.in/courses/112104118/
3. http://fm-nitk.vlabs.ac.in
4. https://www.coursera.org/courses?query=fluid%20mechanics
5. https://apm.iitm.ac.in/fluid_mechanics.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	-	2	2	2
2	3	3	2	3	-	-	-	-	-	-	-	-	2	2	2
3	3	3	2	3	-	-	-	-	-	1	-	1	2	2	2
4	3	3	3	3	-	-	-	-	-	1	-	1	3	3	3
5	3	2	2	3	-	-	-	-	-	1	-	1	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

Annexure 1.6

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE
(An Autonomous Institution)
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)
(Accredited by NBA-AICTE, New Delhi, ISO 9001:2008 Certified Institution & Accredited by NAAC with 'A' Grade)
Madagadipet, Puducherry - 605 107

B.Tech. (Mechanical) (III-Year/ VI-Semester)

Continuous Assessment Test-1, April-2021

Control System Engineering- ME T65

Day and Date: Thursday & 08.04.2021
Time: 02.00 pm to 03.30 pm **Max. Marks- 50**

Instructions:

IMP: Verify that you have received question paper with correct course, code, branch etc.

i) All questions are compulsory. *ii) Figure to the right indicates full marks.*

iii) Assume suitable data wherever necessary.

Course Outcomes:

CO1: To introduce to the basics of control System Engineering as part of life.

Knowledge Level: K1–Remember, **K2**–Understand, **K3**–Apply, **K4**–Analyze & **K5**–Evaluate

		Marks	B.L	CO's
	PART A (20 Marks)			
	Answer all the Questions			
Q.1	What is control system?	2	K1	CO1
Q.2	Distinguish between open loop and closed loop system	2	K1	CO1
Q.3	What are the effects of feedback on control system?	2	K2	CO1
Q.4	Why negative feedback preferred in control systems?	2	K2	CO1
Q.5	Define open loop system?	2	K2	CO1
Q.6	List out the advantages of closed loop control system	2	K1	CO1
Q.7	List out the advantages of open loop control system	2	K1	CO1
Q.8	List out the basic components of control system	2	K1	CO1
Q.9	Define Actuator.	2	K2	CO1
Q.10	What is servo Mechanism	2	K1	CO1
	PART B (30 Marks)			
	Answer any three Questions			
Q.11	Discuss in detail about Closed loop control system with two suitable examples.	10	K2	CO1
Q.12	Discuss in detail about Open loop control system with two suitable examples.	10	K2	CO1
Q.13	Explain in brief about basic components of control system and its requirements?	10	K2	CO1
Q.14	Discuss about the Mathematical Modeling of Systems and its transfer function	10	K2	CO1

Staff In-charge

T. Kumar
Exam Co-ordinator

HOD/MECH

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

(An Autonomous Institution)
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)
(Accredited by NBA-AICTE, New Delhi, ISO 9001:2000 Certified Institution & Accredited by NAAC with "A" Grade)
Madagadipet, Puducherry - 605 107

B.TECH DEGREE END SEMESTER EXAMINATION FEB/MAR 2021

V Semester

MECHANICAL ENGINEERING

DYNAMICS OF MACHINERY (MET51)

Time: 10.00 am to 01.00 pm **Maximum Marks- 75**

Note: B.L – Bloom's Level; CO's – Course Outcome

		Marks	B.L	CO's
	PART A (10 x 2 = 20 Marks) **Answer all the Questions**			
Q.1	Write the critical function of a flywheel.	2	1	CO1
Q.2	State the conditions for static equilibrium.	2	2	CO1
Q.3	Distinguish between longitudinal and transverse vibration.	2	2	CO2
Q.4	Write a short note on over damping	2	1	CO2
Q.5	With a neat sketch, explain the transverse vibrations.	2	2	CO3
Q.6	Derive the expression for an equivalent length of the torsionally equivalent shaft, replacing a shaft of varying diameter over its length.	2	1	CO3
Q.7	What is the function of a governor?	2	1	CO4
Q.8	Define the term hunting of a governor.	2	1	CO4
Q.9	Prove that maximum secondary unbalanced force is "1/n" times maximum primary unbalanced for "n" cylinders reciprocating engine.	2	1	CO5
Q.10	Why the balancing of rotating parts necessary for high-speed engines?	2	1	CO5
	PART B (5 x 11 = 55 Marks) **Answer all the Questions Choosing one question from each unit**			
Q.11	A single-cylinder, single-acting four-stroke gas engine develops 20 kW at 250 rpm. During the expansion stroke, the workdone is three times the work done on the gases during the compression stroke. The work-done on the suction and exhaust strokes may be neglected. If the flywheel has a mass of 1.5 tons and has a radius of gyration of 0.6 m. Determine the cyclic fluctuation of energy and coefficient of fluctuation of speed	11	3	CO1
	(OR)			
Q.12	The turning moment diagram for a multicylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm = 3° horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: + 52, – 124, + 92, – 140, + 85, – 72 and + 107 mm^2, when the engine is running at a speed of 600 r.p.m. If the total fluctuation of speed is not to exceed ± 1.5% of the mean, find the necessary mass of the flywheel of radius 0.5 m.	11	3	CO1
Q.13	Derive the natural frequency equation of an undamped free longitudinal vibration of a spring-mass system.	11	3	CO2
	(OR)			
Q.14	A vibrating system consists of 8 kg, a spring of stiffness 5.6 N/mm, and a dashpot of damping coefficient of 40 N/m/s. Find: (a) the critical damping coefficient; (b) the damping factor; (c) the natural frequency of damped vibration; (d) the logarithmic decrement; (e) the ratio of two consecutive amplitudes.	11	3	CO2

Q.15	A 1.8 m long hollow shaft is supported in flexible bearings at the ends. It carries two wheels, each of 60 kg mass, one at the center of the shaft and the other at 450 mm from the center. The external and internal diameters of the shaft are 80 mm and 50 mm, respectively. Determine the lowest whirling speed of the shaft. The shaft material density and modulus of elasticity are 7500 kg/m^3 and 210 GN/m^2.	11	3	CO3
	(OR)			
Q.16	A 1.2 m long shaft has a diameter of 45 mm for half the length and 60 mm for the remaining length. One end of the shaft is fixed, and the other carries a rotor of 200 kg mass with a radius of gyration of 45 mm. find the frequency of free torsional vibration neglecting the inertia of the shaft. Take G = 84 GN/m^2.	11	3	CO3
Q.17	Derive the lift equation for porter governor.	11	3	CO4
	(OR)			
Q.18	A Hartnell governor having a central sleeve and two right-angled bell crank levers moves between 290 rpm and 310 rpm for a sleeve lift of 15 mm. The sleeve arms and the ball arms are 80 mm and 120 mm, respectively. The levers are pivoted at 120 mm from the governor axis, and each ball mass is 2.5 kg. The ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine (1) loads on the spring at the lowest and the highest equilibrium speeds and (2) stiffness of the spring.	11	3	CO4
Q.19	The cranks of a two-cylinder uncoupled inside cylinder locomotive are at right angles and are 325 mm long. The cylinders are 675 mm long. The rotating mass per cylinder is 200 kg at the crankpin, and the mass of the reciprocating parts per cylinder is 240 kg. The wheel center lines are 1.5 m apart. The whole of the rotating and two-thirds of the reciprocating masses are to be balanced. The balance masses are to be placed in the planes of the rotation of the driving wheels at a radius of 800 mm. Find the magnitude and direction of the balancing masses.	11	3	CO5
	(OR)			
Q.20	The four masses m_1, m_2, m_3, and m_4 have the radii of rotation as 200 mm, 150 mm, 250 mm, and 300 mm are 200kg, 300 kg, 240 kg, and 260 kg magnitude, respectively. The angles between the successive masses are 45°, 75°, and 135°, respectively. Find the position and magnitude of the balancing mass required if the radius of rotation is 200 mm.	11	3	CO5

Annexure1.7

U20MET202	ENGINEERING METALLURGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn solidification structure, solid solution and allotropy of metals
- To learn the phase diagrams, various reactions and properties of steel
- To learn about the heat treatment and its importance real applications.
- To learn about Recovery, Recrystallization and Grain Growth .
- To learn the deformation and failures of metals.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the fundamentals of solidification, metal structure, solid solution metals. **(K2)**
CO2 - Recognize the phase diagram and equilibrium diagram with reactions. **(K1)**
CO3 - Understand the basic fundamentals of heat treatment and importance in metals. **(K2)**
CO4 - Recognize crystal structure, nucleation, recovery and grain growth. **(K3)**
CO5 - Understand and analysis the behavior of engineering materials and prevention the failures. **(K34)**

UNIT I SOLIDIFICATION AND THEORY OF ALLOYS (9 Hrs)

Mechanism of crystallization, solidification of metals: pure metals and alloys, concept of super cooling, Nucleation: homogenous nucleation and heterogeneous nucleation. Solid solutions : Substitution solid solution- Interstitial solid solution, Hume-Rothery Rule, Lever Rule-Allotropy

UNIT II PHASE DIAGRAM AND IRON- CARBON EQUILIBRIUM DIAGRAM (9 Hrs)

Construction and interpretation of binary phase diagrams – Types – Eutectic, Eutectoid, Peritectic and Peritectoid systems – Iron Carbon equilibrium diagrams – classification of steels and alloy steels – types, manufacturing methods, properties and applications of cast irons.

UNIT III HEAT TREATMENT OF STEELS (9 Hrs)

Introduction to heat treatment- Classifications, Heat treatment of ferritic steels: constant temperature transformation-Continuous cooling curves-Important of heat treatment of steels- Surface Hardening process: classifications- Martempering and Austempering - Heat treatment of stainless steel: austenite stainless steel and Duplex stainless steel- shot peening-laser peening

UNIT IV RECOVERY , RECRYSTALLIZATION AND GRAIN GROWTH (9 Hrs)

Introduction to recovery and recrystallization , recrystallization of time and temperature, Degree of cold work and hot work, recrystallization of original grain growth, laws of recrystallization, Factors affecting rate of recrystallization - Grain growth - normal grain growth and abnormal grain growth- grain orientation- Factors affecting rate of grain growth

UNIT V DEFORMATION AND FAILURES OF METALS (9 Hrs)

Introduction deformation- types-strengthening mechanism of alloys, - ductile and brittle behavior of metals- Ductile to brittle transition- fracture modes – mechanism creep behavior- creep life predictions- fatigue behavior- S-N Curve-design against creep and fatigue

Text Books

1. A. Lavakumar, Concept of in physical metallurgy, Morgan & clay publication,2017
2. Srinivasan, Engineering Materials and Metallurgy, Tata McGraw-Hill Education,2nd edition,2015
3. S. K.Mandal, Steel Metallurgy: Properties, Specifications and Applications, McGraw-Hill Education,2014

Reference Books

1. Romesh C. Sharma, Principles of heat treatment of steels, New Age International, 2010.
2. Sidney H. Avner, Introduction to Physical Metallurgy, Tata McGraw-Hill Publishing company Ltd, 2nd Edition 2008.
3. Kannadi Palankeezhe Balan, Metallurgical Failure Analysis, Elsevier, 2018.
4. L. Krishna reddy, Principles of Engineering Metallurgy, New Age Publishing Company Ltd, 10th Edition 2011.

5. William E. Hosford, Physical Metallurgy, Taylor and Francis , 1st Edition 2018

Web References

1. https://nptel.ac.in/courses/113106088/
2. https://nptel.ac.in/courses/113104074/
3. https://fractory.com/heat-treatment-methods/
4. http://www.phase-trans.msm.cam.ac.uk/2005/growth.html
5. https://www.vssut.ac.in/lecture_notes/lecture1450443095.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	1	1	-	1	-	1	-	1	1	1	1
2	3	1	-	-	-	-	-	1	-	1	-	1	-	1	1
3	3	-	-	-	-	1	-	-	-	1	-	2	-	-	-
4	3	1	1	1	-	1	1	1	-	1	1	2	1	-	1
5	3	2	1	1	2	1	-	1	2	2	1	2	1	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

Annexure1.9

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)
(Accredited by NBA-AICTE, New Delhi, ISO 9001:2000 Certified Institution & Accredited by NAAC with "A" Grade)
(An Autonomous Institution)
(As per UGC Regulations 2018)
Madagadipet, Puducherry - 605 107

Department of Mechanical Engineering

Details of the Induction Program Schedule

Sl. No.	Date/Day	Activity		Staff In-charge
		FN	AN	
Creative Arts and Culture				
1	10.02.2021 & 11.02.2021	Essay writing competition and story chain	Drawing/Painting	1.Mrs.Namitha, AP, English Department 2.Mr.Karupusamy, AP,B.Arch 3. Mr.M.Gunasekar 4.Mr.L.Martin
Creative Arts and Culture				
2	12.02.2021 & 13.02.2021	Singing songs, Mono acting, Extempore and Story Telling	Ad Zap, Elocution and Poem Writing	1. Mr.D.Karunakaran 2.Dr.L.Saravanan 3.Mr.P.Jayakumar 4. Mr.S.Arulpradepp 5.Mr.S.Jagan
Mentoring and Universal Human Values				
3	19.02.2021 & 20.02.2021	Character building, Leadership quality and moral values	Saving of nature in working and studying environment	1.Mr.D.Karunakaran 2.Mr.M.Santhoshkumar 3.Mr.V.Ashok Kumar 4**.** Mr.S.Jagan
Familiarization with college and Department				
4	27.01.2021 & 27.01.2021	About the College and the facilities	About the Department and facilities	1.Dr.K.Velmurugan 2.Dr.G.G.Sozhamannan 3.Dr.K.Hemalatha 4.Dr.T.Coumaressin

Literary Activity and Proficiency Modules				
5	23.02.2021	Books reading, writing summary, debating, enacting roles.	Computer familiarity	1.Dr.K.Pavalavana Pandian 2.Mr.S.Arulpradeep 3.Mr.R.Hemanthkumar 4.Mr.K.Navanithakrishnan
Lectures and workshops by Eminent People				
6	24.02.2021 & 25.02.2021	Recent advancements in Engineering	1.Workshops on two-wheeler dismantling and assembling 2.Workshop on 3D Printing	1.Dr.A.Thiagarajan 2.Dr.R.Ravishankar 3.Mr.E.Manikandan 4.Mr.K.Prakash
Visit in Local Areas				
7	27.02.2021	Industrial Visit		1.Mr.A.Jeyachandran 2.Mr.P.Sathiaprathap 3.Mr.M.Gunasekar
Extra-Curricular Activities				
8	26.02.2021	"MECH Masters" Club Inauguration, Discussion on various activities and divisions of club. Selection of Students coordinators		1.Dr.A.G.Ganeshkumar 2.Dr.L.Saravanan 2.Mr.L.Martin 3.Mr.G.Harish
Physical activity				
9	01.03.2021 & 02.03.2021	Cricket, Football	Basketball	1.Mr.B.R.Vengatesan Physical Director 2.Dr.A.Thiagarajan 3.Mr.K.Giriprasath

Annexure 2

SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

B.TECH.

MECHANICAL ENGINEERING

ACADEMIC REGULATIONS 2019
(R-2019)

CURRICULUM AND SYLLABI

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society.

Mission

M1: Quality Education:

To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation:

To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship:

To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values:

To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

DEPARTMENT VISION AND MISSION

Vision

The Mechanical Engineering department strives to be recognized as an excellent academic and research center for creating outstanding Engineers, Entrepreneurs and Leaders

Mission

M1: Professional Skills:

To provide quality education to enhance students inter-personal and intra-personal skills

M2: State-of-art facilities:

To render excellent infrastructure facilities and laboratories to excel as skilled professionals

M3: Research Exposure:

To Strengthen Research and Development within the department through industrial associations

M4: Employability:

To put enthusiastic exertions to enhance employability and entrepreneurship skills of students

M5: Human Values:

To empower students with professional ethics and human values to serve the society

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge:

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

PO2: Problem analysis:

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

PO3: Design/development of solutions:

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

PO4: Conduct investigations of complex problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage:**

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

PO6: The engineer and society:

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

PO7: Environment and sustainability:

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

PO8: Ethics:

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

PO9: Individual and team work:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication:

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

PO11: Project management and finance:

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

PO12: Life-long learning:

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Technical knowledge

To foster our young graduates with cogent technical knowledge so as to make them employable

PEO2: Real-Time Applications

To apply the acquired knowledge in the field of Mathematics, Science and Engineering in developing real-time projects

PEO 3: Design Ability

To design a system, component or process to meet the desired needs within realistic constraints such as manufacturing, economy, environmental sustainability, social, health and safety

PEO 4: Ethics

To prepare the students to become entrepreneurs with professional attitude in the broader ethical perspective

PEO 5: Life - Long Learning

To craft curiosity among students for life-long learning through self-study

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Solving real time problems

To develop capability to identify, analyze and solve engineering problems in concern to mechanical engineering along with associated engineering streams.

PSO 2: Pursue Professional career

To bestow quality learning environment to pursue professional career in mechanical engineering with integrated knowledge

PSO 3: Concentrating on skill development

To enflame the student’s technical capabilities in engineering design process, intra and inter personnel, linguistic and higher level professional skills required in engineering.

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

Sl. No	Course Category	Breakdown of Credits
1	Humanities and Social Science (HS)	09
2	Basic Sciences(BS)	40
3	Engineering Sciences (ES)	30
4	Professional Core (PC)	65
5	Professional Electives (PE)	18
6	Open Electives (OE)	09
7	Project Work and Internship (PW)	12
8	Employability Enhancement Courses (EEC*)	-
9	Mandatory courses (MC*)	-
Total		**183**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl. No	AICTE Suggested Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences (HS)	-	4	-	-	-	3	1	1	9
2	Basic Sciences (BS)	14	16	3	3	4	-	-	-	40
3	Engineering Sciences (ES)	16	10	4	-	-	-	-	-	30
4	Professional Core (PC)	-	-	14	12	12	15	9	3	65
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	3	3	-	3	-	9
7	Project Work (PW)	-	-	-	-	-	-	2	8	10
8	Internship (PW)	-	-	-	-	-	-	2	-	02
9	Employability Enhancement Courses (EEC*)	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC*)	-	-	-	-	-	-	-	-	-
Total		**30**	**30**	**21**	**21**	**22**	**21**	**20**	**18**	**183**

**** EEC and MC credits are not included for CGPA calculation***

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	T101	Mathematics– I	BS	3	1	0	4	25	75	100
2	T102	Physics	BS	4	0	0	4	25	75	100
3	T103	Chemistry	BS	4	0	0	4	25	75	100
4	T104	Basic Electrical and Electronics Engineering	ES	3	1	0	4	25	75	100
5	T105	Engineering Thermodynamics	ES	3	1	0	4	25	75	100
6	T106	Computer Programming	ES	3	1	0	4	25	75	100
Practical										
7	P101	Computer Programming Lab	ES	0	0	3	2	50	50	100
8	P102	Engineering Graphics	ES	2	0	3	2	50	50	100
9	P103	Basic Electrical and Electronics Lab	ES	0	0	3	2	50	50	100
							30	300	600	900

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	T107	Mathematics–II	BS	3	1	0	4	25	75	100
2	T108	Material Science	BS	4	0	0	4	25	75	100
3	T109	Environmental Science	BS	4	0	0	4	25	75	100
4	T110	Basic Civil and Mechanical Engineering	ES	4	0	0	4	25	75	100
5	T111	Engineering Mechanics	ES	3	1	0	4	25	75	100
6	T112	Communicative English	HS	4	0	0	4	25	75	100
Practical										
7	P104	Physics Laboratory	BS	0	0	3	2	50	50	100
8	P105	Chemistry Laboratory	BS	0	0	3	2	50	50	100
9	P106	Workshop Practice	ES	0	0	3	2	50	50	100
Mandatory Course										
10	P107	NSS/NCC*	MC	0	0	0	-	-	-	-
							30	300	600	900

**** To be completed in I and II semesters, under Pass / Fail option only and not counted for CGPA calculation***

SEMESTER – III										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MET31	Complex Analysis and Applications of Partial Differential Equations	BS	2	2	0	3	25	75	100
2	U19MET32	Electrical and Electronics Engineering	ES	3	0	0	3	25	75	100
3	U19MET33	Mechanics of Solids	PC	2	2	0	3	25	75	100
4	U19MET34	Applied Thermodynamics	PC	2	2	0	3	25	75	100
5	U19MET35	Fluid Mechanics and Machinery	PC	2	2	0	3	25	75	100
6	U19MET36	Engineering Metallurgy	PC	3	0	0	3	25	75	100
Practical										
7	U19MEP31	Electrical and Electronics Engineering Lab	ES	0	0	2	1	50	50	100
8	U19MEP32	Material Testing and Metallurgy Lab	PC	0	0	2	1	50	50	100
9	U19MEP33	Fluid Mechanics and Machinery Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19MEC3X	Certification Course – I **	EEC	0	0	4	-	100	-	100
11	U19MES31	Skill Development Course 1: General Proficiency - I	EEC	0	0	2	-	100	-	100
12	U19MES32	Skill Development Course 2 *	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19MEM31	Physical Education	MC	0	0	2	-	100	-	100
							21	700	600	1300

SEMESTER – IV										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MET41	Probability and Queuing Theory	BS	2	2	0	3	25	75	100
2	U19MET42	Kinematics of Machinery	PC	2	2	0	3	25	75	100
3	U19MET43	Heat and Mass Transfer	PC	2	2	0	3	25	75	100
4	U19MET44	Machining Processes	PC	3	0	0	3	25	75	100
5	U19MEE4X	Professional Elective - I #	PE	3	0	0	3	25	75	100
6	U19XXO4X	Open Elective – I $	OE	3	0	0	3	25	75	100
Practical										
7	U19MEP41	Computer Aided Machine Drawing Lab	PC	0	0	2	1	50	50	100
8	U19MEP42	Heat Transfer Lab	PC	0	0	2	1	50	50	100
9	U19MEP43	Manufacturing Processes Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19MEC4X	Certification Course – II **	EEC	0	0	4	-	100	-	100
11	U19MES41	Skill Development Course 3: General Proficiency - II	EEC	0	0	2	-	100	-	100
12	U19MES42	Skill Development Course 4 *	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19MEM41	Indian Constitution	MC	2	0	0	-	100	-	100
							21	700	600	1300

 # Professional Electives are to be selected from the list given in Annexure I

$ Open electives are to be selected from the list given in Annexure II

**** Certification courses are to be selected from the list given in Annexure III**

*** Skill Development Courses (2 and 4) are to be selected from the list given in Annexure IV**

SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MET51	Numerical Methods and Statistics	BS	2	2	0	3	25	75	100
2	U19MET52	Design of Machine Elements	PC	2	2	0	3	25	75	100
3	U19MET53	Dynamics of Machinery	PC	2	2	0	3	25	75	100
4	U19MET54	Metrology and Measurement	PC	3	0	0	3	25	75	100
5	U19MEE5X	Professional Elective - II #	PE	3	0	0	3	25	75	100
6	U19XXO5X	Open Elective – II $	OE	3	0	0	3	25	75	100
Practical										
7	U19MEP51	Numerical Methods Lab	BS	0	0	2	1	50	50	100
8	U19MEP52	Metrology and Measurements Lab	PC	0	0	2	1	50	50	100
9	U19MEP53	Dynamics Lab	PC	0	0	2	1	50	50	100
10	U19MEP54	CAD/CAM Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U19MEC5X	Certification Course – III **	EEC	0	0	4	-	100	-	100
12	U19MES51	Skill Development Course 5: Foreign Language / IELTS - I	EEC	0	0	2	-	100	-	100
13	U19MES52	Skill Development Course 6: Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U19MEM51	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							22	750	650	1400

SEMESTER – VI										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MET61	Thermal Engineering	PC	2	2	0	3	25	75	100
2	U19MET62	Design of Transmission Systems	PC	2	2	0	3	25	75	100
3	U19MET63	Finite Element Analysis	PC	3	0	0	3	25	75	100
4	U19MET64	Advanced Manufacturing Technology	PC	3	0	0	3	25	75	100
5	U19MEE6X	Professional Elective - III #	PE	3	0	0	3	25	75	100
6	U19XXO6X	Open Elective – III $	HS	3	0	0	3	25	75	100
Practical										
7	U19MEP61	Thermal Engineering lab	PC	0	0	2	1	50	50	100
8	U19MEP62	Computational Fluid Dynamics Lab	PC	0	0	2	1	50	50	100
9	U19MEP63	Manufacturing Technology Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19MEC6X	Certification Course – IV **	EEC	0	0	4	-	100	-	100
11	U19MES61	Skill Development Course 7: Foreign Language / IELTS - II	EEC	0	0	2	-	100	-	100
12	U19MES62	Skill Development Course 8: Technical Seminar	EEC	2	0	0	-	100	-	100
13	U19MES63	Skill Development Course 9: NPTEL / MOOC - I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U19MEM61	Professional Ethics	MC	2	0	0	-	100	-	100
							21	800	600	1400

SEMESTER – VII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MET71	Production Planning and Cost Estimation	PC	3	0	0	3	25	75	100
2	U19MET72	Industrial Automation and Robotics	PC	3	0	0	3	25	75	100
3	U19MEE7X	Professional Elective – IV #	PE	3	0	0	3	25	75	100
4	U19XXO7X	Open Elective – IV $	OE	3	0	0	3	25	75	100
Practical										
5	U19MEP71	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U19MEP72	Automation and Robotics lab	PC	0	0	2	1	50	50	100
7	U19MEP73	Product Development Lab	PC	0	0	2	1	50	50	100
8	U19MEP74	Comprehensive Viva Voce	PC	0	0	2	1	50	50	100
Project Work										
9	U19MEW71	Project Phase - I	PW	0	0	4	2	50	50	100
10	U19MEW72	Internship / Inplant Training	PW	0	0	0	2	100	-	100
							20	500	500	1000

SEMESTER – VIII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MET81	Power Plant Engineering	PC	3	0	0	3	25	75	100
2	U19MEE8X	Professional Elective – V #	PE	3	0	0	3	25	75	100
3	U19MEE8X	Professional Elective – VI #	PE	3	0	0	3	25	75	100
Practical										
4	U19MEP81	Entrepreneurship Management	HS	0	0	2	1	100	-	100
Project Work										
5	U19MEW81	Project Phase - II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U19MES81	Skill Development Course 10: NPTEL / MOOC -II	EEC	0	0	0	-	100	-	100
							18	315	285	600

Annexure - I

PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U19MEE41	Gas Dynamics and Jet propulsion
2	U19MEE42	Computer Aided Design
3	U19MEE43	Product design and Development
4	U19MEE44	Industrial Casting Technology
5	U19MEE45	Non-Conventional Energy Sources
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U19MEE51	Turbo machinery
2	U19MEE52	Powder Metallurgy and Surface Coating
3	U19MEE53	Green Manufacturing
4	U19MEE54	Fluid Power Automation
5	U19MEE55	IOT and Smart Manufacturing
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U19MEE61	Automobile Engineering
2	U19MEE62	Computational Fluid Dynamics
3	U19MEE63	Fuzzy Logic And Neural Networks
4	U19MEE64	Additive Manufacturing
5	U19MEE65	Energy And Climate Change
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U19MEE71	Industrial Tribology
2	U19MEE72	Advanced Welding Technology
3	U19MEE73	Artificial Intelligence and Machine Learning
4	U19MEE74	Nano Technology
5	U19MEE75	Modelling and Simulation of Manufacturing Systems
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U19MEE80	Lean Manufacturing
2	U19MEE81	Cryogenic Engineering
3	U19MEE82	Autotronics
4	U19MEE83	Optimization Techniques in Engineering Design
5	U19MEE84	Total Quality Management
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U19MEE85	Composites Material
2	U19MEE86	Alternative Fuels
3	U19MEE87	Hydrogen Fuels
4	U19MEE88	Maintenance and Safety Engineering
5	U19MEE89	Non-Destructive Evaluation and Testing

Annexure - II

OPEN ELECTIVE COURSES

Sl. No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)				
1	U19EEO41	Solar Photovoltaic Fundamentals and Applications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics
2	U19EEO42	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, BME, IT, CSE
3	U19ECO41	Engineering Computation with MATLAB	ECE	ICE, EEE, MECH, CIVIL, BME, Mechatronics
4	U19ECO42	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics
5	U19CSO41	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U19CSO42	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U19CSO43	Programming in JAVA	CSE	ECE, MECH, Mechatronics
8	U19ITO41	Database System: Design & Development	IT	EEE, ECE, ICE, BME
9	U19ITO42	R programming	IT	EEE, ECE, ICE, BME, MECH, Mechatronics
10	U19ICO41	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL
11	U19ICO42	Control System Engineering	ICE	CSE, IT, MECH
12	U19MEO41	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME
13	U19MEO42	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
14	U19MEO43	Power Plants for Electrical Engineering	MECH	EEE
15	U19CEO41	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics
16	U19CEO42	Building Science and Engineering	CIVIL	EEE, MECH, BME
17	U19BMO41	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
18	U19BMO42	Telemedicine	BME	EEE, ECE, CSE, IT, ICE
19	U19CCO41	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U19CCO42	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics
Open Elective – II / Open Elective – III				
1	U19HSO51 / U19HSO61	Product Development and Design	MBA	**Common to B. Tech** (Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME**) (Offered in Semester VI for **CSE, IT, MECH, Mechatronics**)
2	U19HSO52 / U19HSO62	Intellectual Property and Rights	MBA	
3	U19HSO53 / U19HSO63	Marketing Management and Research	MBA	
4	U19HSO54 / U19HSO64	Project Management for Engineers	MBA	
5	U19HSO55 / U19HSO65	Finance for Engineers	MBA	

Open Elective – II / Open Elective – III (Offered in Semester V for **CSE, IT, MECH, Mechatronics**) (Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME**)				
1	U19EEO53 / U19EEO63	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
2	U19EEO54 / U19EEO64	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics
3	U19ECO53 / U19ECO63	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE MECH, BME, Mechatronics
4	U19ECO54 / U19ECO64	Automotive Electronics	ECE	EEE, ECE, ICE, MECH
5	U19CSO54 / U19CSO64	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
6	U19CSO55 / U19CSO65	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
7	U19ITO53 / U19ITO63	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME
8	U19ITO54 / U19ITO64	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
9	U19ITO55 / U19ITO65	Data Structures	IT	MECH
10	U19ICO53 / U19ICO63	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME
11	U19ICO54 / U19ICO64	Measurement and Instrumentation	ICE	ECE, Mechatronics
12	U19MEO54 / U19MEO64	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
13	U19MEO55 / U19MEO65	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
14	U19CEO53 / U19CEO63	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
15	U19CEO54 / U19CEO64	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
16	U19BMO53 / U19BMO63	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
17	U19BMO54 / U19BMO64	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, MECH, CIVIL , Mechatronics
18	U19CCO53 / U19CCO63	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
19	U19CCO54 / U19CCO64	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U19ADO51 / U19ADO61	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL
21	U19ADO52 / U19ADO62	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics
Open Elective – IV (Offered in Semester VII)				
1	U19EEO75	Hybrid and Electrical Vehicle	EEE	ECE, Mechatronics , MECH
2	U19EEO76	Electrical Energy Conservation and auditing	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
3	U19ECO75	IoT and its Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL
4	U19ECO76	Cellular and Mobile Communications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics
5	U19CSO76	Artificial Intelligence	CSE	EEE, ICE, CIVIL, MECH
6	U19CSO77	Cloud Technology and its Applications	CSE	EEE, ICE, MECH, CIVIL, BME, Mechatronics
7	U19ITO76	Automation Techniques & Tools-DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, BME, Mechatronics

8	U19ITO77	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, BME
9	U19ICO75	Process Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, BME, Mechatronics.
10	U19ICO76	Virtual Instrumentation	ICE	EEE, ECE, MECH, Mechatronics
11	U19MEO76	Principles of Hydraulic and Pneumatic System	MECH	EEE, ECE, ICE, CIVIL
12	U19MEO77	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics
13	U19CEO75	Energy Efficient Buildings	CIVIL	EEE, ECE, MECH
14	U19CEO76	Global Warming and Climate Change	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
15	U19MCO71	Building Automation	Mechatronics	MECH, CIVIL
16	U19MCO72	Automation in Manufacturing Systems	Mechatronics	MECH, CIVIL
17	U19BMO75	Internet of Things for Healthcare	BME	EEE, ECE, ICE
18	U19BMO76	Telehealth Technology	BME	EEE, ECE, ICE
19	U19CCO75	Data Science using python	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME,
20	U19CCO76	Mobile Applications Development using Android	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME,
21	U19ADO73	Data Science Application of NLP	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics
22	U19ADO74	Artificial Intelligence Applications	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME

Annexure - III

EMPLOYABILITY ENHANCEMENT COURSES – (A). CERTIFICATION COURSES

Sl. No	Course Code	Course Title
1	U19MECX1	Python Programming
2	U19MECX2	AutoCAD for Mechanical
3	U19MECX3	CATIA
4	U19MECX4	CREO
5	U19MECX5	Solid works
6	U19MECX6	Fusion 360
7	U19MECX7	ANSYS
8	U19MECX8	Automation – I
9	U19MECX9	Automation – II

Annexure - IV

EMPLOYABILITY ENHANCEMENT COURSES – (B). SKILL DEVELOPMENT COURSES

Sl. No	Course Code	Course Title
1	U19MES31	Skill Development Course 1: General Proficiency - I
2	U19MES32	Skill Development Course 2*
		1) Trouble and Troubleshooting of Two wheeler
		2) Trouble and Troubleshooting of CNC Milling machine
		3) Trouble and Troubleshooting of CNC lathe machine
3	U19MES41	Skill Development Course 3 : General Proficiency - II
4	U19MES42	Skill Development Course 4*
		1) Trouble and Troubleshooting of Four wheeler
		2) Electronic Troubleshooting for Mechanical Engineers
		3) Hardware Networking
5	U19MES51	Skill Development Course 5 : Foreign Language/ IELTS -I
6	U19MES52	Skill Development Course 6 : Presentation Skills using ICT
7	U19MES61	Skill Development Course 7 : Foreign Language/ IELTS - II
8	U19MES62	Skill Development Course 8 : Technical Seminar
9	U19MES63	Skill Development Course 9 : NPTEL / MOOC - I
10	U19MES81	Skill Development Course 10 : NPTEL / MOOC - II

**** Any one course to be selected from the list***

U19MET51 **NUMERICAL METHODS AND STATISTICS** (Common to MECH & CCE)

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- Learn the techniques of solving algebraic and transcendental equations.
- To introduce the numerical techniques of differentiation and integration.
- To know the basic concepts of statistical parameters like mean, median, mode etc.
- To understand the concept of testing of hypothesis using statistical analysis.
- Identify the direction and strength of a linear correlation between two factors.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Solve algebraic and transcendental equations. **(K3)**
CO2 - Apply the knowledge of interpolation by using the numerical methods. **(K3)**
CO3 - Understand the basic concepts of Statistics. **(K2)**
CO4 - Apply the concept of testing of hypothesis for small and large samples. **(K3)**
CO5 - Know the applications of linear regression and correlation. **(K2)**

UNIT I SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS (12 Hrs)

Solution of algebraic and transcendental equations – Newton Raphson method – Gauss elimination method – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel.

UNIT II NUMERICAL DIFFERENTIATION AND INTEGRATION (12 Hrs)

Interpolation: Interpolation by Newton's forward and backward difference formulae for equal intervals – Solution of ordinary differential equations – Single step methods – Taylor series method – Euler methods – Integration by Trapezoidal and Simpson's rules – Lagrange's method for unequal intervals.

UNIT III MEASURES OF DISPERSION (12 Hrs)

Standard deviation – Mean deviation – Quartile deviation – Range – Measures of Skewness and Pearson's coefficient of skewness – Moments about the arbitrary origin and moments based on measures of skewness and kurtosis.

UNIT IV TESTING OF HYPOTHESIS (12 Hrs)

Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means and difference of standard deviations. Small samples: Test for single mean, difference of means and correlation coefficients – test for ratio of variances – Chi–Square test for goodness of fit and independence of attributes.

UNIT V CORRELATION AND REGRESSION (12 Hrs)

Curve fitting - Method of least squares – Correlation – Rank correlation – Regression – Multiple and partial correlation - Plane of regression – Coefficient of multiple correlation – Coefficient of partial correlation.

Text Books

1. B.S.Grewal, "Numerical Methods in Engineering and Science ", Mercury learning & Information, Kindle Edition, 2018.
2. T. Veerarajan and T. Ramachandran, "Statistics and Numerical methods", Mc Graw Hill, 1st Edition, 2019.
3. Richard A. Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018.

Reference Books

1. Rajesh Kumar Guptat, "Numerical Methods, Fundamental and its Applications", Cambridge University, 2019.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition, 2019
3. Timothy Sauer, "Numerical Analysis", Pearson Education, 3rd Edition 2017.
4. Arvind Pragati Gautam, "Numerical Methods", Alpha Science International Limited 2019.
5. N.P.Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.

Web References

1. http://nptel.ac.in/courses/111107063/
2. https://nptel.ac.in/courses/111107119/
3. https://easyengineering.net/ma6452-statistics-and-numerical-methods/
4. https://nptel.ac.in/courses/110/105/110105087/
5. https://nptel.ac.in/courses/111/105/111105077/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	1	-	-	-	-	-	1	3	1	-
2	3	2	1	1	-	1	-	-	-	-	-	1	3	1	-
3	2	1	-	-	-	1	-	-	-	-	-	1	2	2	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	2	-
5	2	1	-	-	-	-	-	-	-	-	-	1	2	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MET52 **DESIGN OF MACHINE ELEMENTS**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To understand the design methodology for machine elements.
- To develop the Knowledge on basic failure mechanisms of riveted and welded joints.
- To learn the design Procedure for the different machine elements such as Keys, Cotters and Knuckle joints.
- To develop knowledge on design dimensions and to compute the stress acting on machine components like shafts and couplings
- To enable the students to understand the design procedure of springs with appropriate assumptions.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the design process and Compute the stress acting on various machine elements. **(K2)**

CO2 - Understand different welded and riveted joints structure and able to apply its knowledge to analyze its strength when subjected to axial and eccentric loading. **(K2)**

CO3 - Design and analyse of keys, cotters and knuckle Joints. **(K4)**

CO4 - Compute the dimensions, stress requirements of shaft and couplings based on various load conditions. **(K5)**

CO5 - Compute the dimensions of the springs for specific applications. **(K5)**

UNIT I DESIGN FUNDAMENTALS (12 Hrs)

Design Process – Computer aided design – Optimum design – Material Standards – Industrial design form and shape design, embodiment design and design for manufacture. Types of loads –Stresses – Static, varying, thermal, impact and residual. Factors of safety – Theories of failure – Stress concentration factors – S-N curves and its applications.

UNIT II DESIGN OF FASTENERS AND WELDED JOINTS (12 Hrs)

Riveted joints-methods of failure of riveted joints strength equations-efficiency of riveted joints- eccentrically loaded riveted joints. Design of fillet welds- axial loads-circular fillet welds-bending and torsion. Design of bolts with pre-stresses- design of joints under eccentric loading -bolts of uniform strength.

UNIT III DESIGN OF KEYS, COTTERS AND KNUCKLE JOINTS (12 Hrs)

Design of Keys-stresses in keys-cottered joints-spigot and socket, sleeve and cotter, jib and cotter joints-Knuckle joints.

UNIT IV DESIGN OF SHAFTS AND COUPLINGS (12 Hrs)

Design of solid and hollow shafts for strength and rigidity – Design of shafts for complex loads– Shaft sizes – BIS code- Design of shafts for gear and belt drives, Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – Pin-Bush coupling.

UNIT V DESIGN OF SPRINGS (12 Hrs)

Stresses and deflections of helical springs-extension compression springs- spring for static and fatigue loading-natural frequency of helical springs-energy storage capacity-helical torsion springs-co-axial springs.

Text Books

1. K.Ganesh Babu, K.Srithar, ‘‘Design of Machine Elements’’, 1st Edition, McGraw Hill, 2009.
2. V.B.Bhandari. ‘‘Design of Machine Elements’’, 4th edition, McGraw Hill Education India, 2017.
3. T.Jagadeesha, ‘‘Design of Machine Elements’’, Universities Press (India) Private limited, Hyderabad, 2018.

Reference Books

1. J.E Shigley, ‘‘Mechanical Engineering Design’’, 6th ed., McGraw-Hill, New York, 2001.
2. R.C.Juvinall, K.M.Marshek, ‘‘Fundamentals of machine component design’’, 6th edition, John Wiley.2011.
3. Design Data Book for Engineers, PSG College of Technology Coimbatore, Kalaikathir Achchagam 2016.
4. Robert L. Norton, ‘‘Machine Design’’ 5th edition Pearson, 2014.
5. Wei Jiang, ‘‘Analysis and Design of Machine Elements’’, Wiley, 2019

Web References

1. https://nptel.ac.in/courses/112/105/112105123/
2. https://nptel.ac.in/courses/112/105/112105124/
3. https://nptel.ac.in/content/storage2/courses/112105125/pdf/modules1.pdf

4. https://www.machinedesign.com/fastening-joining/article/21812672/welded-joints
5. http://www.haynesintl.com/alloys/fabrication-brochure/welding-and-joining/weld-joint-design

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	1	2	1	-	1	-	1	-	1	3	2	2
2	3	2	3	1	2	1	-	1	-	1	-	1	3	2	2
3	3	2	3	1	2	1	-	1	-	1	-	1	3	2	2
4	3	2	3	1	2	1	-	1	-	1	-	1	3	2	2
5	3	2	3	1	2	1	-	1	-	1	-	1	3	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MET53 **DYNAMICS OF MACHINERY**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To perform force analysis and balancing of reciprocating engines and to determine basic parameters of flywheel and its functions
- To understand the effects of free vibration in single degree of freedom systems
- To understand the dynamic effect of undesirable forced vibrations.
- To understand the principles in mechanisms used for speed control and stability control
- To perform balancing of rotating and reciprocating masses

Course Outcomes

After completion of the course, the students will be able to

CO1 - Carry out static and dynamic force analysis on various parts of reciprocating engine and to determine flywheel parameters by constructing turning moment diagram **(K4)**

CO2 - Compute the frequency of free vibration in single degree of freedom systems **(K4)**

CO3 - Compute the frequency of forced vibration in damped and undamped systems **(K4)**

CO4 - Calculate the speed, lift of the governor, and estimate the gyroscopic effect on automobiles, ships and airplanes. **(K4)**

CO5 - Calculate the magnitude and position of reciprocating and rotating masses and thereby to balance them. **(K4)**.

UNIT I DYNAMIC FORCE ANALYSIS (12 Hrs)

Dynamic force analysis – Inertia force and Inertia torque– D'Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses.

UNIT II VIBRATION – SINGLE DEGREE OF FREEDOM SYSTEMS (12 Hrs)

Introduction to vibration – Terminology – Classification of vibrations – Undammed and Damped free vibration of single degree of freedom systems – Viscous damping – Introduction to coulomb damping. Forced vibration – harmonic excitation – Magnification factor – Vibration isolation and Transmissibility.

UNIT III TRANSVERSE AND TORSIONAL VIBRATION SYSTEMS (12 Hrs)

Transverse vibrations of shafts and beams – Rayleigh's and Dunkerley's method – Whirling of shafts. Torsional vibrations – Single rotor, two rotors and three rotors system – Vibration of geared systems.

UNIT IV MECHANISM FOR CONTROL (12 Hrs)

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes – Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes

UNIT V BALANCING (12 Hrs)

Static and dynamic balancing of rotating masses in different planes - partial balancing of reciprocating masses of inline, V, W and radial engines

Text Books

1. S.S.Rattan, Theory of Machines,3rd edition, Tata McGraw-Hill Education India, 2019
2. Sadhu Singh, Theory of Machines: Kinematics and Dynamics, 3rdEdition, Publisher: Pearson Education India, 2014
3. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006

Reference Books

1. John J. Uicker, Joseph E.Shigley, "Theory of Mechanisms and Machines",5th Edition, Oxford Publications, 2016.
2. P.L.Ballaney, Theory of Machines and Mechanisms, 25th Edition, Khanna Publishers, 2016.
3. R.S.Khurmi, "Theory of Machines", 14th Edition, S Chand Publications, 2008.
4. Brian W. Kernighan & Dennis Ritchie. "The C Programming Language", 2nd Edition, Pearson Education India Publications, 2015.
5. J.S.Rao and R.V.Dukkipati - Mechanism and Machine Theory, New Age International Publications, 2014.

Web References

1. https://nptel.ac.in/courses/112104114
2. https:/ ocw.mit.edu
3. http://mm-nitk.vlabs.ac.in/
4. https://nptel.ac.in/courses/112/101/112101096/
5. https://nptel.ac.in/courses/112/106/112106270

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	2	1	2	-	2	-	-	-	2	2	1
2	3	2	2	-	-	1	-	-	2	-	-	-	2	2	1
3	3	2	2	-	2	1	-	-	2	-	-	-	2	2	1
4	3	2	3	-	-	1	-	-	2	-	-	-	2	2	1
5	3	2	2	-	-	1	-	-	2	-	-	-	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MET54 **METROLOGY AND MEASUREMENT**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To provide knowledge on various metrological equipment's available in mechanical industry.
- To understand the basic construction and working of linear and angular measurement tools.
- To understand the basics of modern inspection methods and computerized inspection.
- To acquire about the knowledge on form measurement.
- To understand the various measuring techniques for power, flow and temperature used in industries.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Describe the concepts of measurements to apply in various metrological instruments. **(K1)**
CO2 - Outline the principles of linear and angular measurement tools used for industrial applications. **(K2)**
CO3 - Explain the procedure for conducting computer aided inspection. **(K2)**
CO4 - Demonstrate the techniques of form measurement used for industrial components. **(K2)**
CO5 - Apply various measuring techniques of mechanical properties in industrial needs. **(K3)**

UNIT I BASICS OF METROLOGY (9 Hrs)

Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards.

UNIT II LINEAR AND ANGULAR MEASUREMENTS (9 Hrs)

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchangeability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.

UNIT III ADVANCES IN METROLOGY (9 Hrs)

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.

UNIT IV FORM MEASUREMENT (9 Hrs)

Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.

UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE (9 Hrs)

Force, torque, power - mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orificemeter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration – Readability and Reliability.

Text Books

1. R.K.Rajput, "Engineering Metrology and Instrumentation", S.K. Kataria and Sons Publishers, 2019.
2. R.K.Jain , "Engineering Metrology", Khanna Publishers, 25th Edition 2019.
3. J.P.Hadiya, H.G.Kataria ," Mechanical Measurements and Metrology", Books India Publications, 2018.

Reference Books

1. I.C Gupta, "A Textbook of Engineering Metrology" Paperback Dhanpat Rai Publications, 2019.
2. A.Bewoor and Vinay Kulkarni, "Metrology & Measurement" McGraw Hill Education, 2017.
3. Krishnamurthy Raghavendra, "Engineering Metrology and Measurements" Oxford University Press, 2013.
4. Rega Rajendira,"Principles of Engineering Metrology", Jaico Publishing House, 2008.
5. Backwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2006.

Web References

1. https://nptel.ac.in/courses/112106179/
2. https://nptel.ac.in/courses/112106138/

3. https:// jcboseust.ac.in
4. https://ndl.iitkgp.ac.in/homestudy/engineering
5. http://mech4u.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	-	1	-	-	-	-	1	-	1	2	1	2
2	3	1	1	-	1	-	-	-	-	1	-	1	2	1	2
3	3	1	1	-	1	-	-	-	-	1	-	1	2	1	2
4	3	1	1	-	1	-	-	-	-	1	-	1	2	1	2
5	3	1	1	-	1	-	-	-	-	1	-	1	2	1	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEP51

NUMERICAL METHODS LAB

(Common to ICE & MECH)

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To learn the techniques of solving non-linear equation.
- To find the solutions of simultaneous equations.
- To introduce the numerical techniques of differentiation and integration.
- To understand the curve fitting techniques.
- To study about the single mean and difference of means.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Find out the root of the Algebraic and Transcendental equations. **(K3)**
CO2 - Solve the simultaneous equations. **(K3)**
CO3 - Know the iterative Interpolation formula of integration. **(K3)**
CO4 - Implement Simpsons Rule formula. **(K3)**
CO5 - Solve the Laplace equation using Numerical methods. **(K3)**

List of Experiments

1. Roots of non-linear equation using bisection method.
2. Roots of non-linear equation using Newton's method.
3. Solve the system of linear equations using Gauss - Elimination method.
4. Solve the system of linear equations using Gauss - Seidal iteration method.
5. Solve the system of linear equations using Gauss - Jordan method.
6. Find the area by using trapezoidal rule.
7. Fit a straight line by method of least squares.
8. Fit a parabola by method of least squares.
9. Test for Single mean.
10. Test for difference of mean.

Reference Books

1. C. Xavier, "C Language And Numerical Methods", New Age International, 2007.
2. P. Siva Ramakrishna Das, "Numerical Analysis", Kindle Edition, 2016.
3. Timo Heister, Leo G. Rebholz, FeiXue, "Numerical Analysis an Introduction", Publisher De Gruyter, 2019.
4. K. Sankara Rao, "Numerical Methods for Scientists and Engineers", 3rd Edition, PHI Learning Pvt. Ltd, New Delhi, 2018.
5. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers" McGraw – Hill Higher Education, 2010.

Web References

1. http://nptel.ac.in/courses/111107063
2. http://nptel.ac.in/courses/122102009
3. http://nptel.ac.in/courses/111/107/111107105
4. http://www.math.iitb.ac.in/~baskar/book.pdf
5. https://www.math.ust.hk/~machas/numerical-methods.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	1	-	-	-	-	-	1	-	-	1
2	3	2	1	1	-	1	-	-	-	-	-	1	-	-	1
3	3	2	1	1	-	1	-	-	-	-	-	1	-	-	1
4	3	2	1	1	-	-	-	-	-	-	-	1	-	-	1
5	3	2	1	1	-	-	-	-	-	-	-	1	-	-	1

Correlation Level: 1- Low, 2 - Medium, 3 – High

U19MEP52 **METROLOGY AND MEASUREMENTS LAB**

L	T	P	C	Hrs
0	0	2	1	45

Course Objectives

- To acquaint practical knowledge on various measuring and calibrating devices.
- To familiarize with different measurement equipment's and its usage in industry for quality inspection.
- To explore the working principle of mechanical measuring devices.
- To understand the importance of accurate measurements in the industrial inspection.
- To give exposure and hands on experience about the metrology of tooling.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Calibrate the vernier, micrometer and slip gauges for the inspection. **(K1)**

CO2 - Measure the gear tooth dimensions, angle using sine bar, straightness and flatness, thread parameters, temperature using thermocouple, force, displacement, torque and vibration. **(K1)**

CO3 - Organize experimental investigation of performance of strain gauges, LVDT, Accelerometer, Stroboscope and profile projector. **(K3)**

CO4 - To relate measuring accuracy of different instruments according to the suitability. **(K2)**

CO5 - To extract the results of measurement performed by different equipment's. **(K2)**

List of Experiments

1. Calibration of Micrometer.
2. Measurement of taper using Sine Bar.
3. Tool Maker Microscope (inspection of screws)
4. Straightness and Flatness Measurement using Autocollimator.
5. Surface Roughness Measurement
6. Inspection of Screw Threads (Effective Diameter).
7. Measurement of Pressure using Strain Gauges.
8. Determination of the Time Constant of Thermocouples.
9. Measurement of Force using Transducers.
10. Measurement of Strain using Strain Gauges.
11. Study of Displacement using LVDT
12. Vibration Measurement using Accelerometer.
13. Measurement of speed using stroboscope
14. Inspection of gear tooth profile using profile projectors

Reference Books

1. R.K.Rajput, S.K.Kataria and Sons, Mechanical measurements and instrumentations, S.K.Kataria and Sons, New Delhi, 2013.
2. R.V.Jalgaonkar, Mechanical measurements and Control, Everest publications, New Delhi, 2010.
3. R.K.Jain, Mechanical and Industrial measurements, Khanna publications, New Delhi, 2010.
4. Rega Rajendira ,"Principles of Engineering Metrology", Jaico Publishing House, 2008
5. Backwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2006

Web References

1. https://www.vlab.co.in/participating-institute-iit-bombay
2. http://209.211.220.205/
3. https://sites.google.com/view/vlab-bnmitmech/home
4. https://sites.google.com/site/metrologylabktrsrm/list-of-experiments
5. https://www.bitswgl.ac.in/lab-manuals-mech/1.EM-lab-manuals-converted.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	-	-	-	-	-	1	2	3	2	2
2	3	1	2	2	1	-	-	-	-	-	1	2	2	3	2
3	3	1	2	2	3	-	-	-	-	-	1	2	3	2	2
4	3	2	3	2	1	-	-	-	-	-	1	1	3	3	2
5	3	2	2	2	2	-	-	-	-	-	1	2	3	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEP53 **DYNAMICS LAB**

L	T	P	C	Hrs
0	0	2	1	45

Course Objectives

- To equip the students with the principle of working of various governor and gyroscopic effect
- To nurture the students with the different modes of balancing
- To equip the students with understanding of the various modes of vibration
- To inculcate the knowledge of understanding radius of gyration of given systems
- To instill the knowledge of pressure distribution in bearings and to study the motion analysis of CAM

Course Outcomes

After completion of the course, the students will be able to

CO1 - Demonstrate and perform analysis on various governor and understand the gyroscopic principles **(K4)**

CO2 - Recognize different modes of balancing **(K4)**

CO3 - Identify and analysis different modes of vibration **(K4)**

CO4 - Explain the gyration effect on given systems **(K4)**

CO5 - Interpret the pressure distribution in bearings and demonstrate the CAM motion **(K4)**

List of Experiments

1. Demonstration of four bar inversion mechanism
2. Natural frequency of single mass, single helical spring system
3. Natural frequency of combination of springs – springs in parallel, springs in series
4. Natural frequency of undamped torsional single rotor, double rotor system
   Effect of inertia (I) and stiffness(k)
5. Determination of radius of gyration of a given compound pendulum
6. Determination of radius of gyration, moment of inertia – bifilar suspension method – trifilar suspension method
7. Damping coefficient of torsional single rotor system – Effect of depth of immersion in oil and damping ratio
8. Resonance frequency of equivalent spring mass system – undamped and damped condition
   a) To plot amplitude Vs frequency graph for different damping
9. Determination of characteristic curves of Watt, Porter, Proell and spring loaded governors
10. Static and Dynamic balancing
11. Whirling of shafts/ determination of critical speed with and without Rotors
12. Gyroscopic couple verification
13. Journal bearing – pressure distribution of different loads at different Speeds
14. Cam motion analysis

Reference Books

1. S.S.Rattan, Theory of Machines,3rd edition, Tata McGraw-Hill Education India, 2019.
2. Sadhu Singh, Theory of Machines: Kinematics and Dynamics, 3rd Edition, Publisher: Pearson Education India, 2014.
3. A.Ghosh and A.K.Mallick, “Theory of Mechanisms and Machines", 3rd Edition, Affiliated East-West Pvt. Ltd., New Delhi, 2006.
4. Robert L Norton, “Design of Machinery”, 5th Edition, McGraw Hill Publication, 2011.
5. J.J.Uicker, G.R.Pennock and J.E.Shigley, “Theory of Machines and Mechanisms, 3rd Edition, Oxford University Press, 2009.

Web References

1. http://mm-nitk.vlabs.ac.in/exp28/index.html
2. http://mm-nitk.vlabs.ac.in/exp20/index.html
3. http://vlabs.iitb.ac.in/vlabs-dev/labs/asmlab/labs/exp10/theory.php
4. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/machine_theory/index.php
5 https://mm-nitk.vlabs.ac.in/exp29/index.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
4	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
5	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEP54 **CAD/CAM LAB**

L	T	P	C	Hrs
0	0	2	1	45

Course Objectives

- To understand code of drawing practice as per BIS conventions for mechanical elements using CAD Software and exposure on CNC machines
- Prepare the 2-D and 3-D drawings using parametric solid software's as per industry templates.
- To familiarize on the Structural Analysis of 3D elements using Ansys
- To introduce the concepts of Tool path generation, integration of CAD/CAM with the production machine, and Computer control of machines and processes in manufacturing systems
- To create good understanding on reading, drafting, modeling and analyzing of the given component

Course Outcomes

After completion of the course, the students will be able to

CO1 - Interpret the given drawing as per BIS conventions and exposure in CNC machining. **(K3)**
CO2 - Generate 2-D and 3-D drawings using parametric solid software's as per industry templates. **(K4)**
CO3 - Perform structural analysis on 2D and 3D elements. **(K4)**
CO4 - Extend CAM software to generate NC code. **(K4)**
CO5 - Interpret the given component and perform analysis on 3D elements. **(K4)**

List of Experiments

1. Modeling a component using a 3D Modeling Software and Drafting
2. Model, Assemble and Draft a 3D Product using a 3D Modeling Package
3. Modeling a component and Importing to ANSYS and Meshing
4. Creating APDL in ANSYS for a parametric case study
5. Shear Force and Bending Moment diagram using ANSYS APDL or Workbench
6. Structural Analysis of a 3D Cantilever Beam and Validating the results with 1D and 2D options in ANSYS
7. Programming and machining of given component using CNC turning center.
8. Programming and simulation of given component using CAM software (Lathe).
9. Programming and machining of given component using CNC machining center.
10. Programming and simulation of given component using CAM software (Milling).
11. Programming and machining of given component using Universal Milling Machine.

References/ Manuals/ Software

1. R.K. Singal, Mridul Singal, Rishi Singal. "Fundamentals of Machining and Machine Tools" - I.K. International Publishing Home Pvt. Ltd; New Delhi, 2008.
2. Ken Evans, "Programming of CNC Machines", Industrial Press Inc., U.S.; Fourth edition, 2016.
3. Peter Smid, CNC Programming handbook: a comprehensive guide to practical CNC programming, Industrial press, 2018.
4. Divya Zindani, Working with ANSYS,IK International Publishing House Pvt. Ltd, 2016.

Web References

1. www.CATIA/Creo/Autodesk Inventor/ Solidworks /ANSYS- Software Tutorials
2. https://sites.ualberta.ca/wmoussa/AnsysTutorial
3. https://www.vlab.co.in/broad-area-mechanical-engineering
4. http://vlabs.iitkgp.ernet.in/tcad/
5. https://www.pdfdrive.com/search?q=Duane+Weidinger

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
4	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
5	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MET61 **THERMAL ENGINEERING**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To study the components, systems and performance of internal combustion engines.
- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of Brayton cycle and steam power cycles
- To provide knowledge on steam nozzles and steam turbines
- To impart knowledge on working principles and performance of air compressors
- To apply the thermodynamic concepts into refrigeration and air conditioning

Course Outcomes

After completion of the course, the students will be able to

CO1 - Recognize the components and study the performance of internal combustion engines. **(K2)**
CO2 - Illustrate the working of Brayton and steam power cycles in T-S diagram and formulate its efficiency **(K3)**
CO3 - Analyze the problem relates to steam nozzles and steam turbines **(K3)**
CO4 - Compare the working performance of reciprocating and rotary compressors **(K4)**
CO5 - Estimate the performance of refrigeration and air conditioning **(K4)**

UNIT I IC ENGINES CLASSIFICATION (12 Hrs)

Classification of IC engines – petrol and diesel engines; two stroke and four stroke engines – scavenging in two stroke engines - port and valve timing diagram - fuel supply system in SI and CI engines - ignition system and its types – cooling system and its types – lubrication system and its types - – heat balance test for IC engines.

UNIT II GAS AND STEAM POWER CYCLES (12 Hrs)

Gas power cycle -Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure and air standard efficiency, Steam power cycles-Rankine cycle, Modifications with reheater and regenerator.

UNIT III STEAM NOZZLES AND TURBINES (12 Hrs)

Flow of steam through nozzles, shapes of nozzles, effect of friction – Nozzle efficiency- General relationship between area, velocity and pressure in nozzle flow. Critical pressure ratio - Impulse and reaction principles, compounding, and velocity diagrams for simple turbines, speed regulations – governors. Reheating the steam-Bleeding.

UNIT IV AIR COMPRESSOR (12 Hrs)

Classification - Reciprocating Air Compressor - working principle, work of compression with and without clearance. Multistage air compressor and inter cooling (Descriptive treatment only), Rotary Compressors – Centrifugal Compressor and axial flow compressor (Descriptive treatment only), Screw Compressors

UNIT V REFRIGERATION AND AIR-CONDITIONING (12 Hrs)

Fundamentals of refrigeration and air conditioning - Vapour compression refrigeration cycle- super heat, sub cooling- Performance calculations- Performance calculation of vapour absorption system: Ammonia- Water, Lithium boride- water systems– Alternate refrigerants- Air conditioning systems: types, working principles- Psychrometry - Cooling Load calculations – Concept of RSHF, GSHF, ESHF.

Text Books

1. Frank Kreith Ed, The CRC Handbook of Thermal Engineering, CRC Press LLC, 2013.
2. C.P.Kothandaraman, S.Domkundwar, A.V.Domkundwar “A course in thermal Engineering”, DhanpatRai and sons, 2004.
3. V.Ganesan, “Internal CombustionEngines”, TataMcGraw-Hill, 2007.

References Books

1. W.Willard Pulkrabek– Internal Combustion Engines, Prentice Hall of India, 2003.
2. J.B. Heywood– Internal Combustion Engines – fundamentals, McGraw Hill, 1988.
3. R.Rudramoorthy, “Thermal Engineering”, Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2016.
4. Rajput R.K, Thermal Engineering, 10th edition, Lakshmi Publications, 2018
5. A.Yunus Cengel, Robert H. Turner, John M. Cimbala, Fundamentals of Thermal-Fluid Sciences, Indian edition,2016

Web References

1. https://nptel.ac.in/courses/112/103/112103262/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://nptel.ac.in/courses/112/103/112103275/
4. https://nptel.ac.in/courses/112/106/112106133/
5. https://nptel.ac.in/courses/112/105/112105129/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	1	-	-	2	2	2	3
2	3	2	2	2	-	-	-	-	1	-	-	2	2	2	3
3	3	2	2	2	-	-	-	-	1	-	-	2	2	2	3
4	3	3	3	3	-	-	-	-	1	-	-	2	2	2	3
5	3	3	3	3	-	-	2	-	1	-	-	2	2	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MET62 **DESIGN OF TRANSMISSION SYSTEM**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To study about various transmissions system like belt, ropes and chain drive.
- To correlate difference between spur gears and helical gears and to design.
- To design bevel gears, worm gears and skew gears.
- To select suitable gear box design for specific application.
- To understand different types of clutches and brakes, its failures, applications and determine standard design procedure for single and multi-plate clutches.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Apply the design procedure for belt, rope and chain Drives using Design Data Hand book. **(K3)**
CO2 - Understand the standard geometry, application, failures and design of Spur and Helical Gear. **(K3)**
CO3 - Understand the standard geometry, application, failures and design of Bevel and Worm Gear. **(K3)**
CO4 - Identify the gear box for specific applications **(K3)**
CO5 - Understand different types of clutches and brakes, its failures, applications and determine standard design procedure. **(K3)**

UNIT I BELT, CHAIN AND ROPES (12 Hrs)

Belt Drive: Introduction, types, Material, Design of Belts – Flat Belts and Pulleys – V Belts and Pulleys. Chain and Rope: Design of chain drives – Wire ropes.

UNIT II GEAR DRIVE: SPUR AND HELICAL (12 Hrs)

Spur gears: Introduction, Types of failure, design requirements, gear terminology, design analysis, stress concentration, dynamic load, surface compressive stress, beam strength, gear materials, design procedure, Gear Lubrication.

Helical Gears: Terminology of Helical Gears, Virtual number of teeth, Tooth proportions, Force analysis, Beam strength, Effective Load on gear tooth, design procedure.

UNIT III BEVEL AND WORM GEAR (12 Hrs)

Bevel gears - nomenclature, design of gears – based on bending and wear criteria– based on Lewis and Buckingham equation, worm and worm wheel – nomenclature – design procedure

UNIT IV GEAR BOX (12 Hrs)

Geometric Progression – standard step Ratio- Structural and ray diagrams - Design of sliding mesh gear boxes for machine tools – Design of Speed reducers by using spur and helical gears.

UNIT V MOTION CONTROL: CLUTCHES, BRAKES (12 Hrs)

Internal – Expanding Rim clutches and Brakes – External – Contracting Rim clutches and Brakes – Band type Clutches – Cone clutches and Brakes.

Text Books

1. J.E Shigley and C.R.Mischke, “Mechanical Engineering Design”, McGraw-Hill International; 11th Edition 2019.
2. V Bhandari, “Design of Machine Elements”, Tata McGraw-Hill Book Co, 4th Edition 2016.
3. T.J.Prabhu, Design of Transmission Elements, Madras book house, Chennai, 2018.

References Books

1. R.S. Khurmi, J.K.Gupta. “Machine Design”, Eurasia Publishing House (Pvt.) Ltd. Revised Edition, 2008.
2. Sadhu Singh, “Machine Design”, Khanna Publishing House, 1st Edition 2019.
3. P.C. Gope, “Machine Design – Fundamental and Application”, PHI learning private ltd, New Delhi, 2012.
4. Design Data book– PSG College of Technology, Coimbatore, 2019.
5. A.C Ugural, "Mechanical Design, An Integrated Approach", McGraw Hill Education, 2003.

Web References

1. https://nptel.ac.in/courses/112/103/112103262/
2. https://nptel.ac.in/courses/112106137/

3. https://nptel.ac.in/courses/108/106/108106160/
4. https://nptel.ac.in/courses/112/105/112105234/
5. https://nptel.ac.in/courses/112/105/112105124/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	3	2	-	1	-	-	-	1	3	2	2
2	3	2	3	2	3	2	-	1	-	-	-	1	3	2	2
3	3	2	3	2	3	2	-	1	-	-	-	1	3	2	2
4	3	2	3	2	3	2	-	1	-	-	-	1	3	3	2
5	3	2	3	2	3	2	-	1	-	-	-	1	3	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MET63 **FINITE ELEMENT ANALYSIS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To learn the basic principles of finite element analysis procedure.
- To understand the concepts of discretization
- To learn the theory and characteristics of finite elements that represent engineering structures.
- To understand the nature of iso-parametric and iso-perimetric elements
- To learn and apply finite element solutions to structural, thermal, dynamic problem

Course Outcomes

After completion of the course, the students will be able to

CO1 - Discuss the concepts behind various methods and weighted residual methods in FEM. **(K2)**

CO2 - Describe the discretization concepts. **(K2)**

CO3 - Identify the application and characteristics of FEA elements such as bars, beams, plane and isoperimetric elements, and 3-D element. **(K4)**

CO4 - Compare the iso-parametric and iso-perimetric elements. **(K4)**

CO5 - Identify how the finite element method expands beyond the structural domain, for problems involving in structural dynamics, heat transfer and fluid flow. **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Finite element method, stress and equilibrium, strain – displacement relations, stress – strain relations, plane stress and plane strain conditions, various and weighted residual methods, concept of potential energy, one dimensional problems.

UNIT II DISCRETIZATION (9 Hrs)

Element shapes, discretization procedures, assembly of stiffness matrix, bandwidth, node numbering, mesh generation, interpolation functions, and local and global coordinates, convergence requirements, and treatment of boundary conditions.

UNIT III ANALYSIS OF TRUSSES (9 Hrs)

Finite element modeling coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations. Analysis of Beams: Element stiffness matrix for Hermit beam element, derivation of load vector for concentrated and UDL, simple problems on beams. Modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axisymmetric problems.

UNIT IV HIGHER ORDER AND ISOPARAMETRIC ELEMENTS (9 Hrs)

One dimensional quadratic and cubic elements in natural coordinates, two dimensional four nodded isoperimetric elements and numerical integration.

UNIT V STEADY STATE HEAT TRANSFER ANALYSIS (9 Hrs)

One-dimensional analysis of a fin and two dimensional analysis of thin plate, analysis of a uniform shaft subjected to torsion. Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of Eigen values and Eigen vectors, free vibration analysis.

Text Books

1. Tirupathi R. Chandrupatla, Ashok D. Belegundu, Introduction to Finite Elements in Engineering, 4th Edition, Prentice Hall, 2012.
2. Singiresu S Rao,The Finite Element Methods in Engineering, 6th Edition, Elsevier Butterworth – Heinemann, 2017.
3. Reddy. J.N., “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGraw-Hill, 2005.

Reference Books

1. P.Seshu, “Text Book of Finite Element Analysis”, 3rd Edition, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
2. G.Ramamurthy, “Applied Finite Element Analysis”, 2nd Edition, Wiley Publication, 2010.
3. S.Siddu, Anup Goel, Parmeshwar Patil, N. I. Jamader, “Finite Element Analysis”, Technical publications, 2019.
4. C.S.Krishnamurthy, “Finite Element Analysis”, Tata McGraw-Hill, 2000.

5. Robert D Cook, David S Malkus, Michael E Plesha, “Concepts and Applications of Finite Element Analysis”, 4th edition, John Wiley and Sons, Inc., 2003.

Web References

1. https://nptel.ac.in/courses/112104193/
2. https://www.coursera.org
3. https://www.featutorials.com
4. https://www.sciencedirect.com/topics/engineering/finite-element-analysis
5. https://www.comsol.co.in/multiphysics/finite-element-method

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	2	1	-	-	-	-	-	1	3	2	1
2	3	2	2	2	2	1	-	-	-	-	-	1	3	2	1
3	3	2	2	2	2	1	-	-	-	-	-	1	3	2	1
4	3	2	3	2	2	1	-	-	-	-	-	1	3	2	1
5	3	2	2	2	2	1	-	-	-	-	-	1	3	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MET64 **ADVANCED MANUFACTURING TECHNOLOGY**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To study about the introduction of unconventional machining processes.
- To study about micro machining process and its material removal mechanism.
- To learn about the micro fabrication.
- To learn about the importance of numerical control machines.
- To impart the knowledge of group technology and flexible manufacturing system.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Acquire knowledge about unconventional machining process and advantages. **(K2)**
CO2 - Get a broad view about micro machining and simulation of atomic scale level **(K2)**
CO3 - Get knowledge about modern micro fabrication processes. **(K3)**
CO4 - Acquire knowledge about numerical control machines. **(K2)**
CO5 - Become familiarize with group technology and flexible manufacturing systems. **(K3)**

UNIT I NON TRADITIONAL MACHINING PROCESSES (9 Hrs)

Introduction to Non-traditional machining, Need for Non-traditional machining process, Comparison between traditional and non-traditional machining. Selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes. Introduction, equipment and material process of EDM, ECM, ECG, AJM and USM

UNIT II MICRO MACHINING PROCESS (9 Hrs)

Micromachining – definition - principle of mechanical micromachining - Classification of micromachining and Nano finishing processes. Molecular dynamics simulations of machining at atomic scale. Diamond Turn Machining (DTM) - components of DTM – requirements of DTM - material removal mechanism – molecular dynamics - tool geometry

UNIT III MICRO FABRICATION (9 Hrs)

Materials for Microsystems manufacture - Substrates and Wafers, active substrate materials, silicon and silicon components. Photolithography based micro fabrication processes - Photo resist development. Additive and subtractive techniques – CVD – PVD – etching - chemical, plasma - resists removal. Large aspect ratio micro manufacturing - LIGA, Deep Reactive Ion Etching.

UNIT IV NUMERICAL CONTROL MACHINES (9 Hrs)

N.C. machines – Introduction. Types, Economics advantages and applications, CNC, DNC (Direct and Distributed). Turning and Machining centres– Description and Types of ATC, applications.NC part programming – Types – Introduction to programming languages, APT programming, Examples on CNC Turning, Milling & Drilling operations, Preliminary study on simulation of CAD based NC programming**.**

UNIT V GROUP TECHNOLOGY (9 Hrs)

Group Technology: Part families – parts classification and coding. Examples ROC Algorithm, Applications. Flexible Manufacturing systems – Types, components, planning and implementation Issues. Introduction of Learn and Agile Manufacturing systems – Comparison

Text Books

1. Mikel P. Groover, Automation, Production Systems and Computer Integrated manufacturing,PHI Ltd., New Delhi, 2018
2. Kalpakjian, Schmid. “Manufacturing Engineering and Technology”6th edition, Prentice Hall 2010
3. G.Boothroyd et al, Automatic Assembly, Marcel Dekker Inc., New York, 1993

Reference Books

1. Chua C.K., Leong K.F., And Lim C.S., “Rapid Prototyping: Principles and Applications”, Third
2. Edition, World Scientific Publishers, 2010
3. P. Radhakrishnan, NC Machine Tools, Dhanpat Rai & Sons, New Delhi, 2000
4. P. Radhakrishnan and S. Subramanian – CAD/CAM/CIM, Wiley Eastern Ltd., 2000.

5. P.N. Rao et al, Computer Aided Manufacturing, Tata McGraw Hill Publishers, 1993.

Web References

1. http://nptel.ac.in/courses/112104028/
2. https://nptel.ac.in/courses/112/107/112107078/
3. https://nptel.ac.in/courses/112/104/112104289/
4. https://nptel.ac.in/courses/112/107/112107077/
5. https://nptel.ac.in/courses/112/104/112104204/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	-	1	1	1	-	-	-	2	-	1	2
2	3	2	2	-	-	1	1	1	-	-	-	2	-	1	2
3	3	2	2	-	-	1	1	1	-	-	-	2	-	1	2
4	3	2	2	-	-	1	1	1	-	-	-	2	-	1	2
5	3	2	2	-	-	1	1	1	-	-	-	2	-	1	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEP61 **THERMAL ENGINEERING LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To provide knowledge on the performance of steam turbine and boiler
- To understand the function of orsat apparatus and steam calorimeter
- To understand the working principle of cooling tower, refrigeration and Air-conditioning system
- To apply the knowledge to conduct performance test on of IC engines.
- To provide knowledge on Assembly and Dismantle of IC Engines

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the air conditioning, refrigeration system, cooling tower and conduct performance test **(K1)**
CO2 - Summarize the petrol engine and diesel engine performance **(K2)**
CO3 - Apply the theoretical and actual knowledge to draw valve timing and port timing diagram **(K3)**
CO4 - Analyse the heat balance test and retardation test on diesel engines **(K4)**
CO5 - Analyse the Engine exhaust gas analysis using Orsat apparatus **(K4)**

List of Experiments

1. Valve and port timing diagrams of 4-stroke and 2-stroke IC engines respectively
2. Performance test on Single/multi cylinder 4-stroke petrol engines
3. Performance test on Single/multi cylinder 4-stroke Diesel engines
4. Heat balance test on IC engines
5. Retardation and motoring test on 4-stroke engine
6. Performance test on Vapour compression Refrigeration system
7. Performance test on Air-conditioning system
8. Performance test on cooling Tower
9. Performance test on Vapour absorption Refrigeration system
10. Engine exhaust gas analysis using Orsat apparatus
11. Performance test on a boiler
12. Performance test on steam turbine
13. Determination of dryness fraction of steam using calorimeter
14. Assembly/Dismantling of Engines to identify the parts and their position in an engine

Reference Books

1. V.Ganesan, “Internal Combustion Engines”, Tata McGraw-Hill Education, 4th Edition, 2012.
2. C.P Arora “Refrigeration and Air Conditioning” Tata McGraw-Hill Education, 3rd Edition, 2009.
3. J.B. Heywood “Internal Combustion Engines” fundamentals, McGraw Hill, 1988. J.B. Heywood– Internal Combustion Engines – fundamentals, McGraw Hill, 1988.
4. R.Rudramoorthy, “Thermal Engineering”, Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2016.
5. R.K Rajput, Thermal Engineering, 10th edition, Lakshmi Publications, 2018

Web References

1. https://nptel.ac.in/courses/112/103/112103262/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://nptel.ac.in/courses/112/103/112103275/
4. https://nptel.ac.in/courses/112/106/112106133/
5. https://nptel.ac.in/courses/112/105/112105129/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	3	-	-	-	2	1	2	2	2	1	3
2	3	2	2	2	3	-	-	-	2	1	2	2	2	1	3
3	3	2	2	2	3	-	-	-	2	1	2	2	2	1	3
4	3	2	2	2	3	-	-	-	2	1	2	2	2	1	3
5	3	2	2	2	3	-	-	-	2	1	2	2	2	1	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEP62 **COMPUTATIONAL FLUID DYNAMICS LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To introduce the students about the science of computational fluid dynamics and heat transfer.
- To teach the students on the concept of boundary layer flow, the principle of viscosity, pressure and flow measurement.
- To apply the simulation techniques on heat flow problems.
- To apply simulation techniques relates to thermal problems.
- To have a clear understanding on FEM software.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the pre and post processing steps in CFD study (**K2)**

CO2 - Apply the concepts of boundary layer flow, the principle of viscosity, pressure and flow measurement (**K3)**

CO3 - Design Optimization using CFD for fluid flow Simulation (**K4)**

CO4 - Design Optimization using CFD for Thermal Simulation (**K4)**

CO5 - Evaluate the problems using FEM software (**K4)**

List of Experiments

1. Internal Pipe flow problem using theoretical FEM.
2. Analyzing Flow in a System of Pipes using ANSYS.
3. Simulate the drag coefficient of a circular cylinder immersed in a uniform fluid stream using ANSYS/Solid Works Flow Simulation.
4. Flow of water through a ball valve assembly using ANSYS/Solid Works Flow Simulation.
5. Heat Conduction within a Solid using ANSYS.
6. Temperature distribution in a fin cooled electronic component using ANSYS.
7. 3D Heat Conduction within a Solid-Cell Phone using ANSYS.
8. Calculation of the efficiency of the counter flow heat exchanger using ANSYS/Solid Works Flow Simulation.
9. Conjugate heat transfer problem using ANSYS/Solid Works Flow Simulation.
10. 3D Thermal Analysis, Finned Pipe using ANSYS.
11. Thermal stress analysis of piston

Reference Books/ Manuals/ Software

1. Janna, W.S., “Design of Fluid Thermal Systems”, Cengage Learning, 3rd Edition, 2011
2. Jaluria, Y., “Design and Optimization of Thermal Systems”, McGraw-Hill, 2nd Edition, 2007.
3. McDonald, A. G., and Magande, H. L., “Thermo-Fluids Systems Design”, John Wiley, 2012.
4. Suryanarayanan, N. V. and Arici, O. “Design and Simulation of Thermal Systems”, McGraw-Hill, 2003.
5. John D. Anderson, “Computational Fluid Dynamics: An Introduction”, Springer, 1992.

Web References

1. https://www.coursera.org/course/spobuildaerodynamics
2. http://nptel.ac.in/courses/101106045
3. http://ocw.mit.edu/
4. courses/aeronautics-and-astronautics/16-100-aerodynamics-fall-2005
5. https://nptel.ac.in/courses/112104193/
6. https://www.featutorials.com

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
3	3	2	2	1	1	-	-	-	-	1	-	1	2	2	1
4	3	3	3	2	2	-	-	-	-	1	-	1	2	2	1
5	3	3	3	2	2	-	-	-	-	1	-	1	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEP63 **MANUFACTURING TECHNOLOGY LAB**

L	T	P	C	Hrs
0	0	2	1	45

Course Objectives

- To Study and acquire knowledge on various basic machining operations in special purpose machines and its applications in manufacturing of components in the industry.
- To acquire knowledge in operation of Milling machines and Hobbing machines.
- To understand the basic concepts of Tool grinding.
- To impart knowledge on dynamometers for measuring cutting force during milling.
- To acquire knowledge in operation of CNC machines.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Demonstrate the various milling operations. **(K2)**
CO2 -.Demonstrate the gear generation profile. **(K2)**
CO3 - Understand the function and applications of tool cutter grinder. **(K2)**
CO4 - Distinguish different measuring devices according to the work. **(K2)**
CO5 - Apply G-code programs to CNC lathes and mills. **(K3)**

List of Experiments

1. Demonstrate of milling machine
2. Cube Milling & step milling
3. Contour Milling using vertical Milling machine
4. Spur Gear cutting in Milling machine
5. Helical Gear Cutting in Milling machine
6. Demonstrate of Gear hobbing machine
7. Gear generation in Hobbing machine
8. Tool grinding in tool and Cutter Grinder
9. Measurement of cutting forces in Milling / Turning Process
10. CNC Part Programming

Reference Books

1. Yoram Koren, “Computer Control of Manufacturing Systems”, McGraw-Hill, 2005.
2. P.N. Rao, “Manufacturing Technology – Metal Cutting and Machine Tools”-Tata Mc Graw Hill Publishing Company Ltd, 2008.
3. Mohd. Mukhtar Alam, Naresh D.N, Girish Chitoshiya, ‘‘Machining and Machine Tools’’, Genius Publication, 2014.
4. S.Kalpakjain, S.Schimd, “Manufacturing Engineering and Technology”, Pearson Education, 7th edition, 2018.
5. Muammer Koc, Tugrul Ozel, ‘‘Modern Manufacturing Processes’’, Wiley, 2019.

Web Resources

1. https://nptel.ac.in/courses/112/107/112107219/
2. https://nptel.ac.in/content/storage2/courses/112105127/pdf/LM-19.pdf.
3. http://electron.mit.edu/~gsteele/mirrors/www.nmis.org/EducationTraining/machineshop/mill/intro.html.
4. http://web.mit.edu/2.810/www/files/lectures/lec5-machining-2018.pdf.
5. https://www.edx.org/course/fundamentals-of-manufacturing-processes.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
4	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
5	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - II

U19MEE51	TURBOMACHINERY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study about the classification of turbo machinery in power generation, power absorption and transportation sectors and thermodynamics of fluid flow in turbo machines
- To learn about energy transfer mechanism in turbine, pumps and compressor and analysis of high speed machines
- To acquire knowledge in classification and operational characteristics of steam turbines
- To acquire knowledge in classification and operational characteristics of hydraulic turbines
- To learn about the classification and working of pumps, compressor and its efficiency

Course Outcomes

After completion of the course, the students will be able to

CO1 - Able to describe turbo machines and analysis the fluid flow in machines. **(K1)**
CO2 - Illustrate the energy exchange mechanism in all turbo machines such as Euler's equation for turbo machinery. **(K1)**
CO3 - Classify the operation and principle of steam turbines. **(K2)**
CO4 - Classify the hydraulic turbines and able to design turbine blades. **(K6)**
CO5 - Perform the preliminary design of turbo machines (pumps, rotary compressors and turbines) and analyse the performance of turbo machinery. (**K6)**

UNIT I INTRODUCTION (9 Hrs)

Introduction: Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Effect of Reynolds number, Unit and specific quantities, model studies.

Thermodynamics of fluid flow: Application of first and second law of thermodynamics to turbo machines, Efficiencies of turbo machines, Static and Stagnation states, Incompressible fluids and perfect gases, overall isentropic efficiency, stage efficiency (their comparison) and polytrophic efficiency for both compression and expansion processes. Reheat factor for expansion process

UNIT II ENERGY EXCHANGE IN TURBO MACHINES (9 Hrs)

Energy exchange in Turbo machines: Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Problems.

General Analysis of Turbo machines: Radial flow compressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance, Theoretical head – capacity relationship, General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, Problems.

UNIT III STEAM TURBINES (9 Hrs)

Steam Turbines: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor. Reaction turbine – Parsons's turbine, condition for maximum utilization factor, reaction staging. Problems.

UNIT IV HYDRAULIC TURBINES (9 Hrs)

Hydraulic Turbines: Classification, various efficiencies. Pelton turbine – velocity triangles, design parameters, Maximum efficiency. Francis turbine - velocity triangles, design parameters, runner shapes for different blade speeds. Draft tubes- Types and functions. Kaplan and Propeller turbines - velocity triangles, design parameters.

UNIT V PUMPS AND COMPRESSORS (9 Hrs)

Centrifugal Pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. Problems.

Centrifugal Compressors: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems. Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and stalling. Problems.

Text Books

1. V. Kadambi and Manohar Prasad, An Introduction to Energy Conversion, Volume III, Turbo machinery, New Age International Publishers, 7th Edition 2018.
2. Maneesh Dubey, BVSSS Prasad, Archana Nema, Turbomachinery, Tata McGraw Hill Co. Ltd., 2018.
3. B.K.Venkanna, Fundamentals of Turbo machinery, Phi Learning Private Limited, 2009.

Reference Books

1. S. M. Yahya, Turbines, Compressors and Fans, Tata McGraw Hill Co. Ltd., 2nd edition, 2002
2. D. G. Shepherd, Principals of Turbo machines, The Macmillan Company, 1964.
3. S. L. Dixon, Fluid Mechanics and Thermodynamics of Turbo machines, Elsevier, 2005.
4. M. S. Govindegouda and A. M. Nagaraj, Text Book of Turbo machines, M. M. Publications, 4th Edition, 2008
5. R. K. Turton, Principles of Turbomachinery, Springer Netherlands, 2012.

Web References

1. https://nptel.ac.in/courses/101/101/101101058/
2. https://nptel.ac.in/courses/112/103/112103249/
3. https://www.youtube.com/watch?v=473XQrJjDZE
4. https://www.youtube.com/watch?v=mLwb4Pk2RZo
5. https://www.sciencedirect.com/science/article/abs/pii/S1359431118361039

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	-	-	-	-	-	-	-	-	1	2	-
2	3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
3	3	3	1	2	-	-	-	-	-	-	-	-	-	2	-
4	3	2	2	3	-	-	-	-	-	-	-	-	-	-	-
5	3	3	2	3	-	-	-	-	-	-	-	-	1	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEE52 **POWDER METALLURGY AND SURFACE COATING**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To make students understand the different types of powder manufacturing methods and applications.
- To teach the characterization techniques and testing of metal powders
- To make them understand the powder compaction methods and selection of methods
- To learn about the different types of sintering techniques and uses
- To understand powder metallurgy application in aerospace, automobile and machining materials

Course Outcomes

After completion of the course, the students will be able to

CO1 - Acquire the knowledge of Powder Metallurgy History, Applications and its manufacturing methods. **(K1)**
CO2 - Gain knowledge about powder characterizing techniques. **(K2,K4)**
CO3 - Classify the metal powder compaction methods, adhesives and Surface coatings. **(K3)**
CO4 - Exemplify the suitable sintering techniques for powder metallurgy. **(K3,K4)**
CO5 - Appraise the suitable material for different applications. **(K5)**

UNIT I POWDER MANUFACTURE AND CONDITIONING (9 Hrs)

Mechanical methods Machine milling, ball milling, atomization, shotting- Chemical methods, condensation, thermal decomposition, carbonyl Reduction by gas-hydride, dehydride process, electro deposition, precipitation from aqueous solution and fused salts, hydrometallurgical method. Physical methods: Electrolysis and atomisation processes, types of equipment, factors affecting these processes, examples of powders produced by these methods, applications, powder conditioning, heat treatment, blending and mixing, types of equipment, types of mixing and blending, Self- propagating high-temperature synthesis (SHS), sol-gel synthesis- Nano powder production methods.

UNIT II CHARACTERISTICS AND TESTING OF METAL POWDERS (9 Hrs)

Sampling, chemical composition purity, surface contamination etc. Particle size and its measurement, Principle and procedure of sieve analysis, microscopic analysis: sedimentation, elutriation, permeability. Adsorption methods and resistivity methods: particle shape, classifications, microstructure, specific surface area, apparent and tap density, green density, green strength, sintered compact density, porosity, shrinkage.

UNIT III POWDER COMPACTION (9 Hrs)

Pressure less compaction: slip casting and slurry casting. Pressure compaction- lubrication, single ended and double ended compaction, isostatic pressing, powder rolling, forging and extrusion, explosive compaction.

UNIT IV SINTERING (9 Hrs)

Stage of sintering, property changes, mechanisms of sintering, liquid phase sintering and infiltration, activated sintering, hot pressing and Hot isostatic Pressing (HIP), vacuum sintering, sintering furnaces-batch and continuous-sintering atmosphere, Finishing operations – sizing, coining, repressing and heat treatment, special sintering processes- microwave sintering, Spark plasma sintering, Field assisted sintering, Reactive sintering, sintering of nanostructured materials.

UNIT V APPLICATIONS (9 Hrs)

Major applications in Aerospace, Nuclear and Automobile industries- Bearing Materials-types, Self-lubrication and other types, Methods of production, Properties, Applications. Sintered Friction Materials-Clutches, Brake linings, Tool Materials- Cemented carbides, Oxide ceramics, Cermets- Dispersion strengthened materials

Text Books

1. Anish Upadhya and G.S.Upadhaya, “Powder Metallurgy: Science, Technology and Materials, Universities Press, 2018
2. V. Raghavan, “Physical Metallurgy: principles and practice” PHI Learning, 3rd Editions ,2015
3. Cuie Wen “Surface Coating and Modification of Metallic Biomaterial” Woodhead Publishing, 2015.

Reference Books

1. Ramakrishnan. P., Powder Metallurgy-Opportunities for Engineering Industries, Oxford and IBH Publishing Co., Pvt. Ltd, New Delhi, 1987.
2. Isaac Chang YuyuanZhao,”Advances in Powder Metallurgy”, 1st Edition, Woodhead Publishing, 2013.

3. A.K.Sinha, “Powder Metallurgy”, DhanpatRai and Sons, New Delhi, 1982
4. R.M. German, “Powder Metallurgy and Particulate Materials Processing”, Metal Powder Industries Federation, Princeton, NJ, 2005.
5. P.C.Angelo and R.Subramanian., “Powder Metallurgy: Science, Technology and Application” Prentice Hall, 2008

Web References

1. https://nptel.ac.in/courses/113/106/113106098/#
2. https://nptel.ac.in/courses/112/105/112105053/
3. https://youtu.be/uRVaLUQUmA8
4. https://youtu.be/7u54Hx9n3LY
5. https://ironpowders.com/iron-powder-for-surface-coating/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
2	3	3	1	2	1	-	-	-	-	-	-	-	-	-	-
3	3	2	-	1	-	-	-	-	-	-	-	-	-	2	-
4	3	3	1	2	1	-	-	-	-	-	-	-	-	-	-
5	3	3	2	3	2	-	-	-	-	-	-	-	-	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEE53 **GREEN MANUFACTURING**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To describe about sustainable manufacturing, green product and process
- To study the various principles of green manufacturing
- To study about the semiconductor manufacturing and closed loop production systems
- To study about the nano manufacturing and its technologies
- To describe about the packaging and supply chain

Course Outcomes

After completion of the course, the students will be able to

CO1 - Describe the basic design concepts, methods, tools, the key technologies and the operation of sustainable green manufacturing**. (K1)**

CO2 - Appropriate the principles, techniques and methods to customize the learned generic concepts to meet the needs of a particular Industry/enterprise. **(K3)**

CO3 - Recognize the strategies for the purpose of satisfying a set of given sustainable green manufacturing requirements. **(K1)**

CO4 - Use the nanotechnologies in real time applications. **(K3)**

CO5 - Design the rules and processes to meet the market need and the green manufacturing requirements by selecting and evaluating suitable technical, managerial / project management and supply chain management scheme. **(K5,K6)**

UNIT I (9 Hrs)

Introduction to Green Manufacturing: Why Green Manufacturing, Motivations and Barriers to Green Manufacturing, Environmental Impact of Manufacturing, Strategies for Green Manufacturing, Sustainable green manufacturing
The Social, Business, and Policy Environment for Green Manufacturing: Introduction, The Social Environment-Present Atmosphere and Challenges for Green Manufacturing, The Business Environment: Present Atmosphere and Challenges, The Policy Environment - Present Atmosphere and Challenges for Green Manufacturing

UNIT II (9 Hrs)

Metrics for Green Manufacturing" Introduction, Overview of Currently Used Metrics, Overview of LCA Methodologies, Metrics Development Methodologies, Outlook and Research Needs.
Green Supply Chain: Motivation and Introduction, Definition, Issues in Green Supply Chains (GSC), Techniques/Methods of Green Supply Chain, Future of Green Supply Chain.
Principles of Green Manufacturing: Introduction, Background, and Technology Wedges, Principles, Mapping Five Principles to Other Methods and Solutions.

UNIT III (9 Hrs)

Closed-Loop Production Systems: Life Cycle of Production Systems, Economic and Ecological Benefits of Closed Loop Systems, Machine Tools and Energy Consumption, LCA of Machine Tools, Process Parameter Optimization, Dry Machining and Minimum Quantity Lubrication, Remanufacturing, Reuse, Approaches for Sustainable Factory Design.
Semiconductor Manufacturing: Overview of Semiconductor Fabrication, Micro fabrication Processes, Facility Systems, and Green Manufacturing in the Semiconductor Industry: Concepts and Challenges, Use-Phase Issues with Semiconductors, Example of Analysis of Semiconductor Manufacturing.

UNIT IV (9 Hrs)

Environmental Implications of Nano-manufacturing: Introduction, Nano-manufacturing Technologies, Conventional Environmental Impact of Nano-manufacturing, Unconventional Environmental Impacts of Nano-manufacturing, Life Cycle Assessment (LCA) of Nanotechnologies. Green Manufacturing Through Clean Energy Supply Introduction, Clean Energy Technologies, Application Potential of Clean Energy Supplying Green Manufacturing

UNIT V (9 Hrs)

Packaging and the Supply Chain: A Look at Transportation Introduction, Background, Recommended Method to Determine Opportunities for Improved Pallet Utilization, Discussion.
Enabling Technologies for Assuring Green Manufacturing: Motivation, Process Monitoring System, Applying Sensor Flows in Decision Making: Automated Monitoring, Case Study.

Concluding Remarks and Observations about the Future: Introduction, Evolution of Manufacturing, Leveraging Manufacturing, Energy of Labour.

Text Books

1. Ade Asefeso , Green Manufacturing: (Paradigm Shift to Sustainable Capitalism), AA Global Sourcing ltd.,2013
2. Ame,Green Manufacturing: Case Studies in Lean and Sustainability, Productivity Press, 2017
3. Mrityunjay Singh, TatsukiOhji, Rajiv Asthana, Green and Sustainable Manufacturing of Advanced Material, Elsevier, 2015

Reference Books

1. Nand K. Jha , Green Design and Manufacturing for Sustainability, CRC Press,2016
2. World commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.
3. Cairncrss and Francis – Costing the earth – Harvard Business School Press – 2009.
4. T.E Gradel and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
5. A David. Dornfeld Green Manufacturing: Fundamentals and Applications, Springer, 2013

Web References

1. https://nptel.ac.in/courses/112/104/112104225/
2. https://nptel.ac.in/courses/110/104/110104119/
3. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mg24/
4. https://www.youtube.com/watch?v=16vobnhafVw
5. https://www.youtube.com/watch?v=NSzvttpHdWY

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
2	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-
5	3	-	-	-	-	-	2	-	-	-	-	-	-	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEE54 **FLUID POWER AUTOMATION**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To recognize the performance of hydraulic components.
- To recognize the performance of pneumatic components.
- To understand the circuit design methodology and various types of fluid power circuits.
- To identify the various components related to electro-pneumatic and hydraulic circuits.
- To demonstrate the application, basic troubleshooting and maintenance for fluid power system.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Demonstrate the components and performance of hydraulic fluid power system. **(K2)**
CO2 - Demonstrate the components and performance of pneumatic fluid power system. **(K2)**
CO3 - Illustrate the circuit design for fluid power system using various types of circuits. **(K5)**
CO4 - Apply the various components to design electro-pneumatic and hydraulic circuits. **(K3)**
CO5 - Perform basic maintenance and troubleshooting in fluid power systems. **(K2)**

UNIT I HYDRAULIC COMPONENTS (9 Hrs)

Introduction to fluid power system-Pascal's Law-Hydraulic fluids-Hydraulic pumps - Gear, Vane and Piston pumps-Pump Performance-Characteristics and Selection-actuators-valves-pressure control-flow control and direction control valves-Hydraulic accessories-Hydraulic Accumulator.

UNIT II PNEUMATIC COMPONENTS (9 Hrs)

Introduction to Pneumatics-Compressors-types-Air treatment-FRL unit-Air dryer-Control valves-Logic valves-Time delay valve and quick exhaust valve-Pneumatic Sensors–types-characteristics and applications.

UNIT III FLUID POWER CIRCUITS (9 Hrs)

Circuit Design Methodology-Sequencing circuits-Overlapping signals - Cascade method - KV Map method-Industrial Hydraulic circuits - Double pump circuits-Speed control Circuits-Regenerative circuits-Safety circuits-Synchronizing circuits - Accumulator circuits.

UNIT IV ELECTRO - PNEUMATICS AND HYDRAULICS (9 Hrs)

Relay, Switches-Solenoid - Solenoid operated valves -Timer-Counter - Servo and proportional control - Microcontroller and PLC based control-Design of electro-pneumatic and hydraulic circuits.

UNIT V APPLICATION, MAINTENANCE AND TROUBLE SHOOTING (9 Hrs)

Development of hydraulic / pneumatic circuits applied to machine tools-Presses-Material handling systems-Automotive systems-Packaging industries-Manufacturing automation-Maintenance and troubleshooting of Fluid Power circuits-Safety aspects involved.

Text Books

1. S John. Cundiff, Michael F. Kocher, "Fluid Power Circuits and Controls – Fundamental and application", CRC Press LLC, 2nd Edition 2019.
2. R Srinivasan, "Hydraulic & Pneumatic Controls" Vijay Nicole Imprints Pvt Ltd, 3rd Edition 2019.
3. Anthony Esposito, "Fluid Power with applications" Pearson New International Edition, 2013.

Reference Books

1. S.R Majumdar, "Pneumatic systems-principles and maintenance", Tata McGraw Hill, 2017.
2. Ilango Sivaraman, "Introduction to Hydraulics and Pneumatics", PHI Learning Pvt. Ltd, 2017.
3. M. Winston, "Essential Hydraulics: Fluid Power: Volume 2", Create Space Independent Publishing Platform, 2014.
4. Andrew Parr, "Hydraulics and pneumatics", Butterworth-Heinemann, 2011.
5. FESTO, "Fundamentals of Pneumatics", Vol I, II, III.

Web References

1. https://nptel.ac.in/courses/112/105/112105047
2. https://nptel.ac.in/courses/108/105/108105062
3. https://www.youtube.com/watch?v=jKb-KLVzCtw
4. https://www.youtube.com/watch?v=S_4anj7GpRo

5. https://www.youtube.com/watch?v=clVwKynHpB0

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	-	-	-	1	1	2
2	3	2	2	2	-	-	-	-	-	-	-	-	1	2	1
3	3	2	2	-	-	-	-	-	-	-	-	-	2	2	2
4	1	1	2	-	-	-	-	-	-	-	-	-	2	2	1
5	1	3	3	-	-	-	-	-	-	-	-	-	2	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEE55 **IOT AND SMART MANUFACTURING**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To present a problem oriented in depth knowledge of IOT and Smart Manufacturing.
- To address the underlying concepts and methods behind IOT and Smart Manufacturing.
- To learn about the smart manufacturing distinguish its signification in comparison to conventional manufacturing.
- To Study about tools for Smart Manufacturing and its application.
- To study about Smart and Empowered working.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Identify different areas of IOT and Smart Manufacturing. **(K1)**
CO2 - Acquire a broad view about automatic storage management and its governance. **(K2)**
CO3 - Get a knowledge about smart manufacturing. **(K1)**
CO4 - Attain knowledge about smart design and find applications of all the areas in daily life. **(K6)**
CO5 - Become familiarize with elimination of error with smart tools in operations. **(K5)**

UNIT I INTERNET OF THINGS (9 Hrs)

The Internet of Things: An overview; Design Principles for Connected Devices; Internet Principles. Thinking about Prototyping – Costs versus ease of prototyping, prototyping and Production, open source versus Closed Source. Proto typing Embedded devices – Electronics, Embedded Computing Basics, Arduino/ Raspberry Pi/ Beagle Bone Black/ etc., Electric Imp and other notable platforms Prototyping of Physical Design. Prototyping online Components – Getting Started with an API, Writing a New API, Real Time Reactions, Other Protocols. Techniques for Writing Embedded Code – Memory Management, Performance and Battery Life, Libraries and debugging.

UNIT II AUTOMATIC STORAGE MANAGEMENT AND SECURITY (9 Hrs)

Automatic Storage Management in a Cloud World – Introduction to Cloud, Relational Databases in the Cloud, Automatic Storage Management in the Cloud. Smart Connected System Design Case Study Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

UNIT III INTRODUCTION TO SMART MANUFACTURING (9 Hrs)

What is “smart manufacturing” really and how does it differ from conventional/legacy manufacturing-Smart Manufacturing Processes- Three Dimensions: (1) Demand Driven and Integrated Supply Chains;(2) Dynamically Optimized Manufacturing Enterprises (plant + enterprise operations);(3) Real Time, Sustainable Resource Management (intelligent energy demand management, production energy optimization and reduction of GHG)

UNIT IV SMART DESIGN/FABRICATION (9 Hrs)

Smart Design/Fabrication - Digital Tools, Product Representation and Exchange Technologies and Standards, Agile (Additive) Manufacturing Systems and Standards. Mass Customization, Smart Machine Tools, Robotics and Automation (perception, manipulation, mobility, autonomy), Smart Perception – Sensor networks and Devices. Smart Applications: Online Predictive Modelling, Monitoring and Intelligent Control of Machining/Manufacturing and Logistics/Supply Chain Processes; Smart Energy Management of manufacturing processes and facilities

UNIT V SMART AND EMPOWERED WORKERS (9 Hrs)

Eliminating Errors and Omissions, Deskilling Operations, Improving Speed/Agility, Improving Information Capture/Traceability, Improving Intelligent Decision Making under uncertainty Assisted/Augmented Production, Assisted/Augmented Assembly, Assisted/Augmented Quality, Assisted/Augmented Maintenance, Assisted/Augmented Warehouse Operations and Assisted Training

Text Books

1. Zaigham Mahmood - The Internet of Things in the Industrial Sector – Springer – 1st edition – 2019
2. Loveleen Gaur Internet of Things: Approach and Applicability in Manufacturing- Chapman and Hall/CRC -1st Edition - 2019
3. A.McEwen and H. Cassimally, Designing the Internet of Things, 1stedition, Wiley, 2014.

Reference Books

1. N. Vengurlekar and P. Bagal, Database Cloud Storage: The Essential Guide to Oracle Automatic Storage Management, 1st edition, McGraw-Hill Education, 2013.

2. B.K. Tripathy **-** Internet of Things (IoT): Technologies, Applications, Challenges and Solutions - CRC Press 1st Edition 2018.
3. S. Jeschke, C. Brecher, H. Song, and D. B. Rawat, Industrial Internet of Things: Cyber manufacturing Systems, Springer, 1st edition, 2017.
4. A. Bahga and V. Madisetti, Internet of Things, A hands-on approach, Create Space Independent Publishing Platform, 1st edition, 2014.
5. M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann, 2013.

Web References

1. https://nptel.ac.in/courses/106/105/106105195/
2. https://www.digimat.in/nptel/courses/video/106105195/L10.html
3. https://www.youtube.com/watch?v=EV1Ygw6_rCs
4. https://www.sciencedirect.com/journal/internet-of-things
5. https://www.digimat.in/nptel/courses/video/106105195/L01.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-
4	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
5	3	3	2	3	-	-	-	-	-	-	-	-	1	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - III

U19MEE61 **AUTOMOBILE ENGINEERING**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To explain various types of automobiles, their power packs and types of vehicle bodies.
- To analyze the various types of transmission systems for vehicle.
- To analyze the working parameters of various braking and suspension system in a vehicle.
- To study various alternate fuels and its properties.
- To understand various electric, hybrid vehicles and Bharat standards.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Demonstrate the functions chassis, body and frame. **(K3)**
CO2 - Interrupt the knowledge on the types of transmission systems. **(K4)**
CO3 - Establish the different suspension and braking systems. **(K4)**
CO4 - Obtain detailed knowledge about alternate fuels. **(K3)**
CO5 - Acquire knowledge about Bharat standards. **(K3)**

UNIT I INTRODUCTION TO AUTOMOBILE AND TYPES (9 Hrs)

An overview of different types of automobiles - Trends in automobile design - Classification of internal combustion engines - Engine components, Materials and functions - Electronic engine management system for SI and CI engines - Car body construction - General consideration relating to chassis layout - Frame types & materials - Rolling, wind and gradient resultant-factors affecting resistance – Mono point and Multi point injection system - Supercharging - Turbo Chargers – EGR - Catalytic converter - Pollution Norms.

UNIT II CLUTCH AND TRANSMISSION SYSTEMS (9 Hrs)

Requirement of transmission system – clutches – plate clutches – semi automatic & automatic clutches - Gear box: manual shift four speed and positive speed gear boxes - synchromesh devices -fluid transmission – fluid flywheel and torque converter-automatic transmission - drive line - differential, conventional and non-slip types – drive axle-Propeller shaft-Universal joint - Tyres: materials and types - Battery: types.

UNIT III SUSPENSION AND BRAKING SYSTEMS (9 Hrs)

Suspension system – requirements - rigid axle and independent suspension - types of suspension - leaf spring - coil spring - torsion rod and air suspension – shock absorbers. Front axle: types – front wheel geometry - conditions for true rolling. Ackerman and Davis steering –steering linkages - steering gearbox-power and power assisted steering - Wheel alignment - Braking system - hydraulic braking systems - drum type and disc type brakes - power and power assisted brakes - factors affecting brake performance - tests on brakes –ABS- skid and skid prevention.

UNIT IV ALTERNATE FUELS (9 Hrs)

Fuels: classification, properties - Liquid and gaseous fuels - Alternate fuels - Alcohol, LPG, Natural gas, CNG, Gasohol, Bio-diesel and Hydrogen - Combustion & emission characteristics of alternative fuels in SI and CI engines.

UNIT V RECENT TRENDS IN AUTOMOBILE TECHNOLOGY (9 Hrs)

Electric vehicles: classification, Hybrid vehicles - Automotive Sensors & ECU - HCCI and RCCI engines - Autonomous vehicle - Bharath Standards (BS) and its norms - Automotive transmission - Exhaust emissions analysis and its control - Manufacturing trends in automobile industry.

Text Books

1. R.K.Rajput, “Automobile Engineering”, LP publications”, 2nd Edition, 2018.
2. Kirpal Singh, “Automobile Engineering Volume I and II”, Standard Publishers and Distributors, 14th Edition, 2019.
3. N.K. Giri, “Automotive Technology”, Khanna Publishers, 2nd Edition, 2014.

Reference Books

1. P.S.Gill., “A Textbook of Automobile Engineering – Vol. I, II and III”, S.K.Kataria and Sons, 2nd Edition, 2012.
2. D.S.Kumar, “Automobile Engineering”, S.K.Kataria and Sons, 2nd Edition, 2015.

3. Robert Bosch GmbH, “Automotive Handbook”, Robert Bosch, 2004.
4. K.K.Ramalingam, “Automobile Engineering”, Scitech publications, 2011.
5. Halderman, “Automotive Engines: Theory and Servicing”, Pearson, 2019.

Web References

1. https://nptel.ac.in/courses/107106088/
2. https://nptel.ac.in/courses/107/106/107106088/
3. https://www.youtube.com/watch?v=u_CiLG1EkdU
4. https://www.youtube.com/watch?v=IkuIn7TWAl0
5. https://www.youtube.com/watch?v=owjMb76AIvE

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	1	-	-	-	-	-	-	-	-	1	3	1	1
2	3	2	3	-	-	-	-	-	-	-	-	1	3	1	2
3	3	2	3	-	-	-	-	-	-	-	-	1	3	1	2
4	2	2	2	-	-	-	-	-	-	-	-	1	2	1	2
5	2	2	2	-	-	-	-	-	-	-	-	1	2	1	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEE62 **COMPUTATIONAL FLUID DYNAMICS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To expose student to widely used techniques in the numerical solution of fluid equations.
- To develop an understanding for the major theories, approaches and methodologies used in CFD.
- To understand the transformation of coordinates and principles of grid generation.
- To gain experience in the application of CFD analysis to real engineering designs.
- To expose students to various case studies applied to heat and fluid flow.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Solve numerically the governing equations for fluid flow. **(K3)**
CO2 - Analyze the numerical integration the linear algebra methods in various methods. **(K4)**
CO3 - Apply grid generation principles for various problems in CAD interface. **(K3)**
CO4 - Solve numerically a heat transfer and fluid flow problem. **(K3)**
CO5 - Acquire FEM problems in fluid flow and heat transfer by various case studies. **(K3)**

UNIT I EQUATIONS OF FLUID DYNAMICS (9 Hrs)

Basic concepts Eulerarian and Lagrangian methods of describing fluid flow motion, acceleration and deformation of fluid particle, vorticity. Laws governing fluid motion, continuity, Navier – stokes & energy equations. Boundary layer equation, Euler equations, potential flow equations, Bernoulli's equation and vorticity transport equation. Initial and boundary conditions. Classification of equation of motions – hyperbolic, parabolic, elliptic.

UNIT II MATHEMATICAL PRELIMINARIES (9 Hrs)

Numerical integration. Review of linear algebra, solution of simultaneous linear algebraic equations – matrix inversion, solvers – direct methods, elimination methods, ill conditioned systems; Gauss- Sidel method, successive over relaxation method.

UNIT III GRID GENERATION (9 Hrs)

Transformation of coordinates. General principles of grid generation – structured girids in two and three dimensions, algebraic grid generation, differential equations based grid generation; Elliptic grid generation, algorithm, Grid clustering, Grid refinement, Adaptive grids, Moving grids. Algorithms, CAD interfaces to grid generation. Techniques for complex and large problems: Multi block methods.

UNIT IV FINITE DIFFERENCE DISCRETIZATION (9 Hrs)

Elementary finite difference coefficients, basic aspects of finite difference equations, consistency, explicit and implicit methods, errors and stability analysis. Stability of elliptic and hyperbolic equations. Fundamentals of fluid flow modelling-conservative property, upwind scheme, transporting property, higher order unwinding. Finite difference applications in heat transfer – conduction, convection.

UNIT V FINITE VOLUME METHOD (9 Hrs)

Introduction, Application of FVM in diffusion and convection problems, NS equations – staggered grid, collocated grid, SIMPLE algorithm. Solution of discretised equations using TDMA. Finite volume methods for unsteady problems – explicit schemes, implicit schemes. Finite Element Method: Introduction. Weighted residual and variational formulations. Interpolation in one-dimensional and two-dimensional cases. Application of FEM to ID and 2D problems in fluid flow and heat transfer

Text Books

1. Atul sharma, "Introduction to Computational Fluid Dynamics: Development, Application and Analysis:, Wiley publication, 2016.
2. Muralidhar. K and Sundararajan. T, Computational Fluid Flow and Heat Transfer, Narosa Publishing House, 2014.
3. Versteeg. H.K. and Malalasekera. W, "An introduction to computational fluid dynamics", 2nd Edition, Pearson, 2007.

Reference Books

1. Jiyuan Tu Guan Heng Yeoh Chaoqun Liu, "Computational Fluid Dynamics", 3rd Edition, Butterworth-Heinemann, 2018.
2. M.Ramakrishna, "Elements of Computational Fluid Dynamics", A Golden Jubilee Publication, 2011.

3. T.J.Chung, “Computational Fluid Dynamics”, Cambridge University Press, 2002.
4. John F.Wendt, “Computational Fluid Dynamics - An Introduction”, Springer-Verlag, 1992.
5. R.H.Pletcher, J.C.Tannehil and Anderson. D.A, “Computational Fluid Mechanics and Heat Transfer”, Taylor and Francis, 3rd Edition, 2013.

Web References

1. https://nptel.ac.in/courses/101/106/101106045/
2. https://nptel.ac.in/courses/112/105/112105045/
3. https://nptel.ac.in/courses/112/104/112104030/
4. https://nptel.ac.in/courses/112/103/112103289/
5. https://www.youtube.com/watch?v=E9_kyXjtRHc

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	-	-	-	-	-	-	-	-	1	3	3	3
2	3	3	3	-	-	-	-	-	-	-	-	1	3	3	3
3	2	2	2	-	-	-	-	-	-	-	-	1	2	1	2
4	2	2	2	-	-	-	-	-	-	-	-	1	2	1	2
5	3	2	2	-	-	-	-	-	-	-	-	1	3	3	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEE63 **FUZZY LOGIC AND NEURAL NETWORKS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To expose the concepts of fuzzy set theory and its operations.
- To provide adequate knowledge about modeling and control of fuzzy logic.
- To understand the different hybrid control schemes and its case study.
- To provide adequate knowledge about modeling and control of neural networks.
- To understand the ANN structures and online learning algorithms.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Generalize the concept of fuzziness involved in various systems and fuzzy set theory. **(K2)**
CO2 - Apply the fuzzy logic control and adaptive fuzzy logic to design the fuzzy control. **(K3)**
CO3 - Utilize the hybrid control schemes in Neuro Fuzzy Systems. **(K3)**
CO4 - Acquire the concepts of Neural Networks for modeling and controls. **(K3)**
CO5 - Execute the knowledge of ANN structures and online training algorithms. **(K3)**

UNIT I FUZZY SET THEORY (9 Hrs)

Fuzzy set theory- fuzzy sets- operation on fuzzy sets- Scalar cardinality, fuzzy cardinality, union and intersection complement (Yeger and sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation- fuzzy membership functions

UNIT II FUZZY LOGIC FOR MODELING AND CONTROL (9 Hrs)

Modelling of nonlinear systems using fuzzy models – TSK model – fuzzy logic controller- fuzzification – knowledge base- decision making logic – de fuzzification – adaptive fuzzy systems – Familiarization with fuzzy logic toolbox

UNIT III HYBRID CONTROL SCHEMES (9 Hrs)

Fuzzification and rule base using ANN – Neuro fuzzy systems ANFIS – Fuzzy neuron – Introduction to GA – Optimization of membership function and rule base using Genetic algorithm – Introduction to support vector machine – particle swarm optimization – case study – familiarization with ANFIS toolbox

UNIT IV NEURAL NETWORKS FOR MODELLING AND CONTROL (9 Hrs)

Modelling of non-linear systems using ANN- generation of training data – optimal architecture – model validation – control of non- linear systems using ANN – direct and indirect neuro control schemes – adaptive neuro controller – familiarization with neural network toolbox

UNIT V ANN STRUCTURES AND ONLINE TRAINING ALGORITHMS (9 Hrs)

Recurrent neural network (RNN) - Adaptive resonance theory (ART) based network- Radial basis function network- Online learning algorithms: BP through time - RTRL algorithms – Least Mean square algorithm - Reinforcement learning.

Text Books

1. Laurene V.Fausett, “Fundamentals of Neural Networks, Architecture, Algorithms, and Applications”, Pearson Education, 2013.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, Wiley, 3rd Edition, 2010.
3. David E.Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Pearson Education, 2013.

Reference Books

1. W.T.Miller, R.S.Sutton and P.J.Webrose, “Neural Networks for Control”, MIT Press, 3rd Edition 2010.
2. George J.Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic: Theory and Applications”, PHI, 1st Edition, 1995.
3. Charu C. Aggarwal, “Neural Networks and Deep Learning, Springer, 2018.
4. B.Kosko, “Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence”, Prentice Hall, New Delhi, 2004.
5. Kayacan, M.Erdal, “Fuzzy neural networks for real time control applications”, Elsevier, 1st Edition, 2015.

Web References

1. https://nptel.ac.in/courses/127/105/127105006/
2. https://www.tutorialspoint.com/fuzzy_logic/fuzziness_in_neural_networks.htm
3. http://www.scholarpedia.org/article/Fuzzy_neural_network

4. https://www.youtube.com/watch?v=phMLnHZgrnQ
5. https://www.youtube.com/watch?v=xwUKQcT1bKc

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1	-	-	-	-	-	-	-	-	1	1	1	1
2	3	2	2	-	-	-	-	-	-	-	-	1	2	3	3
3	3	3	3	-	-	-	-	-	-	-	-	1	3	2	2
4	3	2	2	-	-	-	-	-	-	-	-	1	1	3	2
5	2	3	3	-	-	-	-	-	-	-	-	1	3	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEE64 **ADDITIVE MANUFACTURING**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the basic needs, principle and applications of rapid prototyping.
- To understand the design tools of additive manufacturing.
- To identify the materials, process and application of Photo polymerization and Powder Bed Fusion.
- To learn the principles of Extrusion Based and Sheet Lamination process.
- To understand the application of Beam Deposition process.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the role of additive manufacturing in the design process and the implications for design. **(K2)**
CO2 - Apply the design tools in additive manufacturing for medical applications. **(K3)**
CO3 - Analyze the processes of Photo polymerization and Powder Bed Fusion. **(K4)**
CO4 - Illustrate extrusion based process systems. **(K4)**
CO5 - Develop the additive manufacturing process and materials applications. **(K5)**

UNITI INTRODUCTION (9 Hrs)

Overview – Need - Development of Additive Manufacturing Technology - Principle – AM Process Chain- Classification – Rapid Prototyping- Rapid Tooling – Rapid Manufacturing – Applications- Benefits –Case studies.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING (9 Hrs)

Design tools: Data processing - CAD model preparation – Part orientation and support structure generation – Model slicing –Tool path generation- Design for Additive Manufacturing: Concepts and objectives- AM unique capabilities – DFAM for part quality improvement- Customised design and fabrication for medical applications.

UNIT III PHOTO POLYMERIZATION AND POWDER BED FUSION PROCESSES (9 Hrs)

Photo polymerization: SLA-Photo curable materials – Process - Advantages and Applications. Powder Bed Fusion: SLS-Process description – powder fusion mechanism – Process Parameters – Typical Materials and Application. Electron Beam Melting.

UNIT IV EXTRUSION BASED AND SHEET LAMINATION PROCESSES (9 Hrs)

Extrusion Based System: FDM-Introduction – Basic Principle – Materials – Applications and Limitations – Bioextrusion. Sheet Lamination Process: LOM- Gluing or Adhesive bonding – Thermal bonding.

UNIT V PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES (9 Hrs)

Droplet formation technologies – Continuous mode – Drop on Demand mode – Three Dimensional Printing – Advantages – Bioplotter - Beam Deposition Process: LENS- Process description – Material delivery – Process parameters – Materials – Benefits – Applications.

Text Books

1. Ian Gibson, David W.Rosen, Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing” Springer, 2010.
2. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third edition, World Scientific Publishers, 2010.
3. Andreas Gebhardt “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing” Hanser Gardner Publication 2011.

Reference Books

1. A.K.Kamrani and E.A.Nasr, “Rapid Prototyping: Theory and practice”, Springer, 2006.
2. L.W Liou and F.W Liou, “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 2007.
3. Tom Page “Design for Additive Manufacturing” LAP Lambert Academic Publishing, 2012.
4. Amit Bandyopadhyay, Susmita bose , “Additive Manufacturing”, CRC Press, 2015
5. Di Nicolantonio, Massimo, Rossi, Emilio, Alexander, Thomas “Advances in Additive Manufacturing, Modeling Systems and 3D Prototyping”, Proceedings of the AHFE 2019.

Web References

1. https://nptel.ac.in/courses/112/104/112104265/

2. https://nptel.ac.in/courses/112/107/112107078/
3. https://additivenews.com/videos/
4. https://www.journals.elsevier.com/additive-manufacturing
5. https://www.springer.com/journal/40964

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	2	2	1	2	1	1	-	2	1	2	1
2	3	1	2	-	2	1	-	2	1	-	-	2	2	2	2
3	3	1	1	1	2	2	1	1	1	-	-	2	2	2	3
4	3	1	1	-	1	1	1	1	1	-	-	2	2	2	3
5	3	1	2	-	2	1	1	1	1	1	2	3	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEE65 **ENERGY AND CLIMATE CHANGE**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To impart knowledge on the global warming, the impact of climate change on society
- To recommend adaptation and mitigation measures
- To understand about the climate change effects on environment
- To provide knowledge on mitigating climate change
- To differentiate alternate and renewable fuels

Course Outcomes

After completion of the course, the students will be able to

CO1 - An insight into carbon cycle, physical basis of the natural greenhouse effect, including the meaning of the term radiative forcing, climate change, global warming and measures **(K3)**

CO2 - Adapt and mitigate the impacts of climate change. **(K2)**

CO3 - Understand the growing scientific consensus established through the IPCC as well as the complexities and uncertainties **(K3)**

CO4 - Plan climate change mitigation and adaptation projects **(K2)**

CO5 - Use of alternate fuels and renewable energy **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Atmosphere – weather and Climate – climate parameters – Temperature, Rainfall, Humidity, Wind – Global ocean circulation – El Nino and its effect – Carbon cycle

UNIT II ELEMENTS RELATED TO CLIMATE (9 Hrs)

Greenhouse gases – Total carbon dioxide emissions by energy sector – industrial, commercial, transportation, residential – Impacts – air quality, hydrology, green space – Causes of global and regional climate change – Changes in patterns of temperature, precipitation and sea level rise – Greenhouse effect

UNIT III IMPACTS OF CLIMATE CHANGE (9 Hrs)

Effects of Climate Changes on living things – health effects, malnutrition, human migration, socioeconomic impacts- tourism, industry and business, vulnerability assessment- infrastructure, population and sector – Agriculture, forestry, human health, coastal areas

UNIT IV MITIGATING CLIMATE CHANGE (9 Hrs)

IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation -Identifying adaption options – designing and implementing adaption measures – surface albedo environment reflective roofing and reflective paving enhancement of evapotranspiration – tree planting programme – green roofing strategies – energy conservation in buildings – energy efficiencies – carbon sequestration.

UNIT V ALTERNATE FUELS AND RENEWABLE ENERGY (9 Hrs)

Energy source – coal, natural gas – wind energy, hydropower, solar energy, nuclear energy geothermal energy – biofuels – Energy policies for a cool future – Energy Audit.

Text Books

1. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2014.
2. Velma. I. Grover “Global Warming and Climate” Change. Vol. I and II. Science Publishers, 2005.
3. Twidell and wier” Renewable energy resources”, CRC press (Taylor and Francis), 2015.

Reference Books

1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK, 2007.
2. Thomas E, Lovejoy and Lee Hannah “Climate Change and Biodiversity”, TERI Publishers, 2018.
3. Jan C. van Dam, Impacts of “Climate Change and Climate Variability on Hydrological Regimes”, Cambridge University Press, 2011.
4. Tiwari and Ghosal” Renewable energy resources” Narosa publications, 2005.
5. Ramesh and Kumar” Renewable Energy Technologies “Narosa publications, 2015.

Web References

1. https://nptel.ac.in/courses/119/106/119106008/
2. https://swayam.gov.in/nd2_arp19_ap55/preview
3. https://nptel.ac.in/courses/103/107/103107157/
4. https://olc.worldbank.org/content/climate-change-online-learning
5. https://nptel.ac.in/courses/119/106/119106015/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	-	2	1	1	-	-	-	2	1	2	2
2	3	1	1	2	-	1	2	1	-	-	-	2	2	1	2
3	3	2	2	1	-	2	1	1	-	-	-	1	1	1	2
4	3	2	1	2	-	2	2	1	-	-	-	1	1	2	1
5	3	2	2	1	-	1	2	1	-	-	-	2	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

Annexure 2.1

		L	T	P	C	Hours
U19MEE87	**ELECTRIC AND HYBRID VEHICLES**	**3**	**0**	**0**	**3**	**45**

Objectives:

1. To study about electric vehicles
2. To study the properties of batteries
3. To discuss about the performance of DC and AC electrical machines
4. To discuss about the transmission and braking system
5. To study about the hybrid electric vehicles

Outcomes:

Upon the completion of this course the students will be able to

1. Acquire knowledge about electric vehicles
2. Acquire knowledge about battery design, properties
3. To gain knowledge about performance of DC and AC electrical machines
4. Acquire knowledge about transmission and braking system
5. To gain knowledge about hybrid electric vehicles.

UNIT I ELECTRIC VEHICLES **9 Hours**

UNIT I 9 Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

UNITII BATTERY **9 Hours**

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

UNIT III DC & AC ELECTRICAL MACHINES **9 Hours**

Motor and Engine rating, Requirements, DC machines, Three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.

UNITIV ELECTRIC VEHICLE DRIVE TRAIN & HYBRID VEHICLES **9 Hours**

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing. Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.

UNITV MASS RAPID TRANSIT SYSTEM (MRTS) **9 Hours**

MRTS Introduction – Types of MRTS – Metro rail transmit system - Mono rail transmit system - Light rail transmit system **Total: 45 hours**

TEXTBOOKS:

1.Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.

2.James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.

3. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2000

4. O'Reilly “Hybrid Electric Vehicles”, 2nd Edition, 2015

5. Wiley “Electric Vehicle Technology Explained”, 2nd Edition | 2016

REFERENCES:

1. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles And Applications With Practical Perspectives, Wiley Publication, 2011..
2. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press, 2001
3. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
4. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003
5. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 2005

WEBSITE:

1. http://nptel.ac.in/courses/108103009/
2. https://nptel.ac.in/courses/108/102/108102121/
3. https://nptel.ac.in/courses/108/106/108106170/

CO/PO MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	3	2	-	-	-	-	2
CO2	3	2	2	1	1	3	2	-	-	-	-	2
CO3	3	2	2	1	1	3	2	-	-	-	-	2
CO4	3	2	2	1	1	3	2	-	-	-	-	2
CO5	3	2	2	1	1	3	2	-	-	-	-	2

Annexure 3

SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

B.TECH.

MECHANICAL ENGINEERING

ACADEMIC REGULATIONS 2020
(R-2020)

CURRICULUM AND SYLLABI

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society.

Mission

M1: Quality Education:

To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation:

To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship:

To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values:

To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

DEPARTMENT VISION AND MISSION

Vision

The Mechanical Engineering department strives to be recognized as an excellent academic and research center for creating outstanding Engineers, Entrepreneurs and Leaders

Mission

M1: Professional Skills:

To provide quality education to enhance students inter-personal and intra-personal skills

M2: State-of-art facilities:

To render excellent infrastructure facilities and laboratories to excel as skilled professionals

M3: Research Exposure:

To Strengthen Research and Development within the department through industrial associations

M4: Employability:

To put enthusiastic exertions to enhance employability and entrepreneurship skills of students

M5: Human Values:

To empower students with professional ethics and human values to serve the society

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge:

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

PO2: Problem analysis:

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

PO3: Design/development of solutions:

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

PO4: Conduct investigations of complex problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage:**

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

PO6: The engineer and society:

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

PO7: Environment and sustainability:

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

PO8: Ethics:

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

PO9: Individual and team work:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication:

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

PO11: Project management and finance:

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

PO12: Life-long learning:

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Technical knowledge

To foster our young graduates with cogent technical knowledge so as to make them employable

PEO2: Real-Time Applications

To apply the acquired knowledge in the field of Mathematics, Science and Engineering in developing real-time projects

PEO 3: Design Ability

To design a system, component or process to meet the desired needs within realistic constraints such as manufacturing, economy, environmental sustainability, social, health and safety

PEO 4: Ethics

To prepare the students to become entrepreneurs with professional attitude in the broader ethical perspective

PEO 5: Life - Long Learning

To craft curiosity among students for life-long learning through self-study

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Solving real time problems

To develop capability to identify, analyze and solve engineering problems in concern to mechanical engineering along with associated engineering streams.

PSO 2: Pursue Professional career

To bestow quality learning environment to pursue professional career in mechanical engineering with integrated knowledge

PSO 3: Concentrating on skill development

To enflame the student’s technical capabilities in engineering design process, intra and inter personnel, linguistic and higher level professional skills required in engineering.

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

Sl. No	Course Category	Breakdown of Credits
1	Humanities and Social Science (HS)	7
2	Basic Sciences(BS)	22
3	Engineering Sciences (ES)	25
4	Professional Core (PC)	71
5	Professional Electives (PE)	18
6	Open Electives (OE)	9
7	Project Work and Internship (PW)	12
8	Employability Enhancement Courses (EEC*)	-
9	Mandatory courses (MC*)	-
Total		**164**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl. No	Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences (HS)	-	-	1	1	-	3	1	1	07
2	Basic Sciences(BS)	9	3	3	3	4	-	-	-	22
3	Engineering Sciences (ES)	9	5	7	4	-	-	-	-	25
4	Professional Core (PC)	-	13	11	8	12	15	9	3	71
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	3	3	-	3	-	09
7	Project Work (PW)	-	-	-	-	-	-	2	8	10
8	Internship (PW)	-	-	-	-	-	-	2	-	02
9	Employability Enhancement Courses (EEC*)	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC*)	-	-	-	-	-	-	-	-	-
Total		**18**	**21**	**22**	**22**	**22**	**21**	**20**	**18**	**164**

**** EEC and MC credits are not included for CGPA calculation***

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST101	Engineering Mathematics – I (Calculus and Linear Algebra)	BS	2	2	0	3	25	75	100
2	U20BST106	Physics For Mechanical Engineering	BS	3	0	0	3	25	75	100
3	U20BST107	Material Science and Engineering	BS	3	0	0	3	25	75	100
4	U20EST117	Basic Electrical and Electronics Engineering	ES	3	0	0	3	25	75	100
5	U20EST119	Engineering Mechanics	ES	2	2	0	3	25	75	100
Practical										
6	U20ESP118	Basic Electrical and Electronics Engineering Lab	ES	0	0	2	1	50	50	100
7	U20ESP120	Engineering Mechanics Lab	ES	0	0	2	1	50	50	100
8	U20ESP121	Engineering Practice Lab	ES	0	0	2	1	50	50	100
Employability Enhancement Course										
9	U20MEC1XX	Certification Course - I **	EEC	0	0	4	-	100	-	100
10	U20MES101	Skill Development Course 1*	EEC	0	0	2	-	100	-	100
Mandatory Course										
11	U20MEM101	Induction Program	MC	3 Weeks			-	-	-	-
							18	475	525	1000

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST215	Engineering Mathematics - II (Multiple Integrals and Transforms)	BS	2	2	0	3	25	75	100
2	U20EST201	Programming in C	ES	3	0	0	3	25	75	100
3	U20MET201	Manufacturing Processes	PC	3	0	0	3	25	75	100
4	U20MET202	Engineering Metallurgy	PC	3	0	0	3	25	75	100
5	U20MET203	Concepts of Engineering Design	PC	3	0	0	3	25	75	100
6	U20MET204	Engineering Thermodynamics	PC	2	2	0	3	25	75	100
Practical										
7	U20ESP202	Programming in C Lab	ES	0	0	2	1	50	50	100
8	U20ESP212	Engineering Graphics using Auto CAD	ES	0	0	2	1	50	50	100
9	U20MEP201	Manufacturing Processes Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20MEC2XX	Certification Course – II **	EEC	0	0	4	-	100	-	100
Mandatory Course										
11	U20MEM202	Environmental Science	MC	2	0	0	-	100	-	100
							21	500	600	1100

 # Professional Electives are to be selected from the list given in Annexure I

$ Open electives are to be selected from the list given in Annexure II

**** Certification courses are to be selected from the list given in Annexure III**

*** Skill Development Courses (2 and 4) are to be selected from the list given in Annexure IV**

SEMESTER – III										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST320	Complex Analysis and Applications of Partial Differential Equations	BS	2	2	0	3	25	75	100
2	U20EST356	Data Structures	ES	3	0	0	3	25	75	100
3	U20EST358	Electronic Devices and Circuits	ES	3	0	0	3	25	75	100
4	U20MET305	Mechanics of Solids	PC	2	2	0	3	25	75	100
5	U20MET306	Computer Aided Design	PC	2	2	0	3	25	75	100
6	U20MET307	Fluid Mechanics and Machinery	PC	2	2	0	3	25	75	100
Practical										
7	U20HSP301	General Proficiency - I	HS	0	0	2	1	50	50	100
8	U20ESP357	Data Structures Lab	ES	0	0	2	1	50	50	100
9	U20MEP302	Material Testing and Metallurgy Lab	PC	0	0	2	1	50	50	100
10	U20MEP303	Fluid Mechanics and Machinery Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20MEC3XX	Certification Course – III **	EEC	0	0	4	-	100	-	100
12	U20MES302	Skill Development Course 2*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20MEM303	Physical Education	MC	0	0	2	-	100	-	100
							22	650	650	1300

SEMESTER – IV										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST433	Probability and Queuing Theory	BS	2	2	0	3	25	75	100
2	U20EST467	Programming in JAVA	ES	3	0	0	3	25	75	100
3	U20MET408	Kinematics of Machinery	PC	2	2	0	3	25	75	100
4	U20MET409	Heat and Mass Transfer	PC	2	2	0	3	25	75	100
5	U20MEE4XX	Professional Elective - I #	PE	3	0	0	3	25	75	100
6	U20XXO4XX	Open Elective – I $	OE	3	0	0	3	25	75	100
Practical										
7	U20HSP402	General Proficiency - II	HS	0	0	2	1	50	50	100
8	U20ESP468	Programming in JAVA Lab	ES	0	0	2	1	50	50	100
9	U20MEP404	Computer Aided Machine Drawing Lab	PC	0	0	2	1	50	50	100
10	U20MEP405	Heat Transfer Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20MEC4XX	Certification Course – IV**	EEC	0	0	4	-	100	-	100
12	U20MES403	Skill Development Course 3*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20MEM404	NSS	MC	0	0	2	-	100	-	100
							22	650	650	1300

SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST548	Numerical Methods and Statistics	BS	2	2	0	3	25	75	100
2	U20MET510	Design of Machine Elements	PC	2	2	0	3	25	75	100
3	U20MET511	Dynamics of Machinery	PC	2	2	0	3	25	75	100
4	U20MET512	Metrology and Measurement	PC	3	0	0	3	25	75	100
5	U20MEE5XX	Professional Elective – II #	PE	3	0	0	3	25	75	100
6	U20XXO5XX	Open Elective - II $	OE	3	0	0	3	25	75	100
Practical										
7	U20BSP549	Numerical Methods Lab	BS	0	0	2	1	50	50	100
8	U20MEP506	Metrology and Measurements Lab	PC	0	0	2	1	50	50	100
9	U20MEP507	Dynamics Lab	PC	0	0	2	1	50	50	100
10	U20MEP508	CAD/CAM Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20MEC5XX	Certification Course – V **	EEC	0	0	4	-	100	-	100
12	U20MES504	Skill Development Course 4: Foreign Language/ IELTS-I	EEC	0	0	2	-	100	-	100
13	U20MES505	Skill Development Course 5: Hands-on Training in 3D Printing	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U20MEM505	Indian Constitution	MC	2	0	0	-	100	-	100
							22	750	650	1400

SEMESTER – VI										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20MET613	Thermal Engineering	PC	2	2	0	3	25	75	100
2	U20MET614	Design of Transmission Systems	PC	2	2	0	3	25	75	100
3	U20MET615	Finite Element Analysis	PC	3	0	0	3	25	75	100
4	U20MET616	Advanced Manufacturing Technology	PC	3	0	0	3	25	75	100
5	U20MEE6XX	Professional Elective – III #	PE	3	0	0	3	25	75	100
6	U20XXO6XX	Open Elective - III $	HS	3	0	0	3	25	75	100
Practical										
7	U20MEP609	Thermal Engineering lab	PC	0	0	2	1	50	50	100
8	U20MEP610	Computational Fluid Dynamics Lab	PC	0	0	2	1	50	50	100
9	U20MEP611	Manufacturing Technology Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20MEC6XX	Certification Course – VI **	EEC	0	0	4	-	100	-	100
11	U20MES606	Skill Development Course 6: Foreign Language/ IELTS-II	EEC	0	0	2	-	100	-	100
12	U20MES607	Skill Development Course 7: Technical Seminar	EEC	0	0	2	-	100	-	100
13	U20MES608	Skill Development Course 8: NPTEL/MOOC -I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U20MEM606	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	800	600	1400

SEMESTER – VII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20MET717	Production Planning and Cost Estimation	PC	2	2	0	3	25	75	100
2	U20MET718	Industrial Automation and Robotics	PC	3	0	0	3	25	75	100
3	U20MEE7XX	Professional Elective - IV #	PE	3	0	0	3	25	75	100
4	U20XXO7XX	Open Elective - IV $	OE	3	0	0	3	25	75	100
Practical										
5	U20HSP703	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U20MEP712	Automation and Robotics lab	PC	0	0	2	1	50	50	100
7	U20MEP713	Product Development Lab	PC	0	0	2	1	50	50	100
8	U20MEP714	Comprehensive Viva Voce	PC	0	0	2	1	50	50	100
Project Work										
9	U20MEW701	Project Phase - I	PW	0	0	4	2	50	50	100
10	U20MEW702	Internship / Inplant Training	PW	-	-	-	2	100	-	100
Mandatory Course										
11	U20MEM707	Professional Ethics	MC	2	0	0	-	100	-	100
							20	600	500	1100

SEMESTER – VIII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20MET819	Power Plant Engineering	PC	2	2	0	3	25	75	100
2	U20MEE8XX	Professional Elective – V #	PE	3	0	0	3	25	75	100
3	U20MEE8XX	Professional Elective – VI #	PE	3	0	0	3	25	75	100
Practical										
4	U20HSP804	Entrepreneurship Management	HS	0	0	2	1	100	-	100
Project Work										
5	U20MEW803	Project Phase - II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U20MES809	Skill Development Course 9: NPTEL/MOOC - II	EEC	0	0	0	-	100	-	100
							18	315	285	600

ANNEXURE I

PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U20MEE401	Gas Dynamics and Jet propulsion
2	U20MEE402	Geometric Tolerance and Dimensioning
3	U20MEE403	Product design and Development
4	U20MEE404	Industrial Casting Technology
5	U20MEE405	Non-Conventional Energy Sources
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U20MEE506	Turbo Machinery
2	U20MEE507	Powder Metallurgy and Surface Coating
3	U20MEE508	Green Manufacturing
4	U20MEE509	Fluid Power Automation
5	U20MEE510	IOT and Smart Manufacturing
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U20MEE611	Automobile Engineering
2	U20MEE612	Computational Fluid Dynamics
3	U20MEE613	Fuzzy Logic And Neural Networks
4	U20MEE614	Additive Manufacturing
5	U20MEE615	Energy And Climate Change
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U20MEE716	Industrial Tribology
2	U20MEE717	Advanced Welding Technology
3	U20MEE718	Artificial Intelligence and Machine Learning
4	U20MEE719	Nano Technology
5	U20MEE720	Modelling and Simulation of Manufacturing Systems
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20MEE821	Lean Manufacturing
2	U20MEE822	Cryogenic Engineering
3	U20MEE823	Autotronics
4	U20MEE824	Optimization Techniques in Engineering Design
5	U20MEE825	Total Quality Management
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20MEE826	Composites Material
2	U20MEE827	Alternative Fuels
3	U20MEE828	Hydrogen Fuels
4	U20MEE829	Maintenance and Safety Engineering
5	U20MEE830	Non-Destructive Evaluation and Testing

ANNEXURE - II

OPEN ELECTIVE COURSES

S. No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)				
1	U20EEO401	Solar Photovoltaic Fundamental and applications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE
2	U20EEO402	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE, BME, IT, CSE, FT
3	U20ECO401	Engineering Computation with MATLAB	ECE	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS, Mechatronics
4	U20ECO402	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics, FT
5	U20CSO401	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U20CSO402	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U20ITO401	Database System: Design & Development	IT	EEE, ECE, ICE, CCE, BME
8	U20ITO402	R programming	IT	EEE, ECE, ICE, CCE, BME, MECH, Mechatronics
9	U20ICO401	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL, CCE, AI&DS, FT
10	U20ICO402	Control System Engineering	ICE	CSE, IT, MECH, CCE, AI&DS
11	U20MEO401	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME, FT
12	U20MEO402	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
13	U20MEO403	Industrial Engineering for Textile	MECH	FT
14	U20CEO401	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics, FT
15	U20CEO402	Building Science and Engineering	CIVIL	EEE, MECH, BME
16	U20BMO401	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics, AI&DS
17	U20BMO402	Telemedicine	BME	EEE, ECE, CSE, IT, ICE, CCE, AI&DS
18	U20CCO401	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20CCO402	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics
20	U20ADO401	Knowledge Representation and Reasoning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
21	U20ADO402	Introduction to Data Science	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics

Open Elective – II / Open Elective – III				
1	U20HSO501/ U20HSO601	Product Development and Design	MBA	**Common to B. Tech** (Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**) (Offered in Semester VI for **CSE, IT, MECH, Mechatronics, AI&DS**)
2	U20HSO502/ U20HSO602	Intellectual Property and Rights	MBA	
3	U20HSO503/ U20HSO603	Marketing Management and Research	MBA	
4	U20HSO504/ U20HSO604	Project Management for Engineers	MBA	
5	U20HSO505/ U20HSO605	Finance for Engineers	MBA	
Open Elective – II / Open Elective – III (Offered in Semester V for **CSE, IT, MECH, Mechatronics, AI&DS**) (Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**)				
1	U20EEO503/ U20EEO603	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS, FT
2	U20EEO504/ U20EEO604	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics, AI&DS
3	U20ECO503/ U20ECO603	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE, MECH, CCE, BME, Mechatronics
4	U20ECO504/ U20ECO604	Automotive Electronics	ECE	EEE, ECE, ICE, MECH
5	U20CSO503/ U20CSO603	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, CCE, BME, AI&DS
6	U20CSO504/ U20CSO604	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, FT
7	U20ITO503/ U20ITO603	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME
8	U20ITO504/ U20ITO604	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics, AI&DS
9	U20ICO503/ U20ICO603	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME, AI&DS
10	U20ICO504/ U20ICO604	Measurement and Instrumentation	ICE	ECE, Mechatronics
11	U20MEO504/ U20MEO604	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO505/ U20MEO605	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
13	U20CEO503/ U20CEO603	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
14	U20CEO504/ U20CEO604	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20BMO503/ U20BMO603	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics
16	U20BMO504/ U20BMO604	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL , Mechatronics

17	U20CCO503/ U20CCO603	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
18	U20CCO504/ U20CCO604	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20ADO503/ U20ADO603	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE
20	U20ADO504/ U20ADO604	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
21	U20MCO501/ U20MCO601	Industrial Automation for Textile	Mechatronics	FT
Open Elective – IV (Offered in Semester VII)				
1	U20EEO705	Hybrid and Electrical Vehicle	EEE	ECE, Mechatronics , MECH
2	U20EEO706	Electrical Energy Conservation and auditing	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS
3	U20ECO705	IoT and its Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, FT
4	U20ECO706	Cellular and Mobile Communications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
5	U20CSO705	Artificial Intelligence	CSE	EEE, ICE, CIVIL, CCE, MECH, FT
6	U20CSO706	Cloud Technology and its Applications	CSE	EEE, ICE, MECH, CIVIL, CCE, BME, Mechatronics
7	U20ITO705	Automation Techniques & Tools-DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, CCE, BME, Mechatronics, AI&DS
8	U20ITO706	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS
9	U20ICO705	Process Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
10	U20ICO706	Virtual Instrumentation	ICE	EEE, ECE, MECH, Mechatronics
11	U20MEO706	Principles of Hydraulic and Pneumatic System	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO707	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics
13	U20CEO705	Energy Efficient Buildings	CIVIL	EEE, ECE, MECH
14	U20CEO706	Global Warming and Climate Change	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20MCO702	Building Automation	Mechatronics	MECH, CIVIL
16	U20MCO703	Automation in Manufacturing Systems	Mechatronics	MECH, CIVIL

17	U20BMO705	Internet of Things for Healthcare	BME	EEE, ECE, ICE, CCE
18	U20BMO706	Telehealth Technology	BME	EEE, ECE, ICE, CCE
19	U20CCO705	Data Science using python	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U20CCO706	Mobile Applications Development using Android	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
21	U20ADO705	Data Science Application of NLP	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics.
22	U20ADO706	Artificial Intelligence Applications	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME
23	U20HSO706	Industrial Safety and Human Resource Management	MBA	FT
24	U20HSO707	Operation Research in Textile Industry	MBA	FT
25	U20HSO708	Global marketing and Sourcing Strategies	MBA	FT
26	U20HSO709	Fashion Advertising and sales promotions	MBA	FT
27	U20HSO710	Luxury Brand management	MBA	FT
28	U20HSO711	Fashion Retail Store Operations	MBA	FT

ANNEXURE-III

EMPLOYABILITY ENHANCEMENT COURSES - (A) CERTIFICATION COURSES

Sl. No.	Course Code	Course Title
1	U20MECX01	3ds Max
2	U20MECX02	Advance Structural Analysis of Building using ETABS
3	U20MECX03	Advanced Java Programming
4	U20MECX04	Advanced Python Programming
5	U20MECX05	Analog System Lab Kit
6	U20MECX06	Android Medical App Development
7	U20MECX07	Android Programming
8	U20MECX08	ANSYS -Multiphysics
9	U20MECX09	Artificial Intelligence
10	U20MECX10	Artificial Intelligence and Edge Computing
11	U20MECX11	Artificial Intelligence in Medicines
12	U20MECX12	AutoCAD for Architecture
13	U20MECX13	AutoCAD for Civil
14	U20MECX14	AutoCAD for Electrical
15	U20MECX15	AutoCAD for Mechanical
16	U20MECX16	Azure DevOps

17	U20MECX17	Basic Course on ePLAN
18	U20MECX18	Basic Electro Pneumatics
19	U20MECX19	Basic Hydraulics
20	U20MECX20	Bio Signal and Image Processing Development System
21	U20MECX21	Blockchain
22	U20MECX22	Bridge Analysis
23	U20MECX23	Building Analysis and Construction Management
24	U20MECX24	Building Design and Analysis Using AECO Sim Building Designer
25	U20MECX25	CATIA
26	U20MECX26	CCNA (Routing and Switching)
27	U20MECX27	CCNA (Wireless)
28	U20MECX28	Cloud Computing
29	U20MECX29	Computer Programming for Medical Equipments
30	U20MECX30	Corel Draw
31	U20MECX31	Creo (Modeling and Simulation)
32	U20MECX32	Cyber Security
33	U20MECX33	Data Science and Data Analytics
34	U20MECX34	Data Science using Python
35	U20MECX35	Data Science using R
36	U20MECX36	Deep Learning
37	U20MECX37	Design and Documentation using ePLAN Electric P8
38	U20MECX38	Design of Biomedical Devices and Systems
39	U20MECX39	Digital Marketing
40	U20MECX40	Digital Signal Processing Development System
41	U20MECX41	DigSILENT Power Factory
42	U20MECX42	Electro Hydraulic Automation with PLC
43	U20MECX43	Embedded System using Arduino
44	U20MECX44	Embedded System using C
45	U20MECX45	Embedded System with IoT
46	U20MECX46	ePLAN Data Portal
47	U20MECX47	ePLAN Electric P8
48	U20MECX48	ePLAN Fluid
49	U20MECX49	ePLAN PPE
50	U20MECX50	Fusion 360
51	U20MECX51	Fuzzy Logic and Neural Networks
52	U20MECX52	Google Analytics
53	U20MECX53	Hydraulic Automation
54	U20MECX54	Industrial Automation
55	U20MECX55	Industry 4.0
56	U20MECX56	Internet of Things
57	U20MECX57	Introduction to C Programming
58	U20MECX58	Introduction to C++ Programming

59	U20MECX59	IoT using Python
60	U20MECX60	Java Programming
61	U20MECX61	Machine Learning
62	U20MECX62	Machine Learning and Deep Learning
63	U20MECX63	Machine Learning for Medical Diagnosis
64	U20MECX64	Mechatronics
65	U20MECX65	Medical Robotics
66	U20MECX66	Microsoft Dynamics 365 ERP for HR , Marketing and Finance
67	U20MECX67	Mobile Edge Computing
68	U20MECX68	Modeling and Visualization using Micro station
69	U20MECX69	MX Road
70	U20MECX70	Photoshop
71	U20MECX71	PLC
72	U20MECX72	Pneumatics Automation
73	U20MECX73	Project Management
74	U20MECX74	Python Programming
75	U20MECX75	Revit Architecture
76	U20MECX76	Revit Inventor
77	U20MECX77	Revit MEP
78	U20MECX78	Robotics
79	U20MECX79	Search Engine Optimization
80	U20MECX80	Software Testing
81	U20MECX81	Solar and Smart Energy System with IoT
82	U20MECX82	Solid Works
83	U20MECX83	Solid Works with Electrical Schematics
84	U20MECX84	Speech Processing
85	U20MECX85	STAAD PRO V8i
86	U20MECX86	Structural Design and Analysis using Bentley
87	U20MECX87	Total Station
88	U20MECX88	Video and Image Processing Development System
89	U20MECX89	VLSI Design
90	U20MECX90	Web Programming - I
91	U20MECX91	Web Programming - II

ANNEXURE - IV

EMPLOYABILITY ENHANCEMENT COURSES - (B) SKILL DEVELOPMENT COURSES

Sl. No.	Course Code	Course Title
1	U20MES101	Skill Development Course 1: Demonstration in Civil Engineering
2	U20MES302	Skill Development Course 2 *
		1) Trouble and Troubleshooting of Two wheeler
		2) Trouble and Troubleshooting of CNC Milling machine
		3) Trouble and Troubleshooting of CNC lathe machine
3	U20MES403	Skill Development Course 3 *
		1) Trouble and Troubleshooting of Four wheeler
		2) Electronic Troubleshooting for Mechanical Engineers
		3) Hardware Networking
4	U20MES504	Skill Development Course 4: Foreign Language/ IELTS-I
5	U20MES505	Skill Development Course 5: Hands-on Training in 3D Printing
6	U20MES606	Skill Development Course 6: Foreign Language/ IELTS-II
7	U20MES607	Skill Development Course 7: Technical Seminar
8	U20MES608	Skill Development Course 8: NPTEL/MOOC-I
9	U20MES809	Skill Development Course 9: NPTEL/MOOC-II

**** Any one course to be selected from the list***

U20BST320	COMPLEX ANALYSIS AND APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS (Common to EEE, ICE, MECH, MECHATRONICS)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the analytic functions of complex variables.
- To apply the analytic function techniques to transform irregular geometry into regular geometry.
- Expose to the concept of complex integration.
- To understand the nature of wave equations.
- To know the solutions of one dimensional and two-dimensional heat flow equations.

Course Outcomes

After completion of the course, the students will be able to

CO1- Understand the concepts of function of a complex variable. **(K2)**
CO2 - Transform complex functions from one plane to another plane. **(K3)**
CO3 - Apply the concepts of complex integration over contour. **(K3)**
CO4 - Understand the concept of initial and boundary value problems **(K2)**
CO5 - Solve the one and two dimensional heat equation using Fourier series. **(K3)**

UNIT I FUNCTION OF A COMPLEX VARIABLE (12 Hrs)

Continuity, derivative and analytic functions – Necessary conditions – Cauchy-Riemann equations and sufficient conditions – Harmonic and orthogonal properties of analytic function – Construction of analytic function

UNIT II CONFORMAL MAPPINGS (12 Hrs)

Conformal mapping – Simple and standard transformations like $w = z+c$, cz, z^2, e^z, sin z, cosh z and $z+1/z$ – Bilinear transformation and cross ratio property - Taylor's and Laurent's theorem – Series expansion of complex valued functions – classification of singularities.

UNIT III COMPLEX INTEGRATION (12 Hrs)

Cauchy's integral theorem and its application – Cauchy's integral formula and problems – Residues and evaluation of residues – Cauchy's residue theorem – Contour integration: Cauchy's and Jordan's Lemma – Application of residue theorem to evaluate real integrals – unit circle and semicircular contour.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS (12 Hrs)

Solution of partial differential equation by the method of separation of variables – Boundary value problems – Fourier series solutions of one dimensional wave equation – Transverse vibration of an elastic string.

UNIT V ONE AND TWO DIMENSIONAL HEAT EQUATIONS (12 Hrs)

Fourier series solutions of one dimensional heat flow equation – Fourier series solutions of two dimensional heat flow equation under steady state conditions.

Text Books

1. B. S. Grewal., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 4th Edition, 2020.
2. N.P. Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.
3. P. Sivaramakrishna Das and C. Vijayakumari, "Engineering Mathematics", Pearsons Publications, New Delhi, 4th Edition, 2017.

Reference Books

1. C. Gupta, B. Shree Ram Singh, M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, New Delhi, 1st Edition, 2015.
2. H.K. Dass & Dr. Rama Verma, "Introduction to Engineering Mathematics – Volume II", S. Chand & Co, New Delhi, 9th Edition, 2019.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition, 2019.
4. Ravish R. Singh and Mukul Bhatt, "Engineering Mathematics", Tata McGraw Hill, New Delhi, 1st Edition, 2016.
5. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 3rd Edition, 2018.

Web References

1. https://nptel.ac.in/courses/122107036/
2. https://nptel.ac.in/courses/111107119/
3. https://youtu.be/W3HXK1Xe4nc
4. https://youtu.be/Mwpz1zjPlzI
5. https://youtu.be/CnrAivf9I6o

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	1	1	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	1	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	1	1	-
4	2	1	-	-	-	1	-	-	-	-	-	1	2	2	-
5	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

DATA STRUCTURES

L	T	P	C	Hrs
3	0	0	3	45

U20EST356

(Common to ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHATRONICS,CCE)

Course Objectives

- To impart the basic concepts of data structures and its terminologies.
- To understand concepts about stack and queue operations.
- To understand basic concepts about linked list and its various operations.
- To understand concepts about Tree and its applications.
- To understand basic concepts about Sorting, Hashing and Graph.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Compute time and space complexity for given problems **(K3)**

CO2 - Demonstrate stack, queue and its operation. **(K3)**

CO3 - Illustrate the various operations of linked list. **(K3)**

CO4 - Use the concepts of tree for various applications. **(K3)**

CO5 - Outline the various sorting, hashing and graph techniques. **(K3)**

UNIT I BASIC TERMINOLOGIES OF DATA STRUCTURES (9 Hrs)

Introduction: Basic Terminologies – Elementary Data Organizations. Data Structure Operations: Insertion – Deletion – Traversal. Analysis of an Algorithm. Asymptotic Notations. Time-Space trade off. Array and its operations. Searching: Linear Search and Binary Search Techniques – Complexity analysis.

UNIT II STACK AND QUEUE OPERATIONS (9 Hrs)

Stacks and Queues: ADT Stack and its operations. Applications of Stacks: Expression Conversion and evaluation. ADT Queue and its operations. Types of Queue: Simple Queue – Circular Queue – Priority Queue – Deque.

UNIT III LINKED LIST OPERATIONS (9 Hrs)

Linked Lists: Singly linked list: Representation in memory. Algorithms of several operations: Traversing – Searching – Insertion – Deletion. Linked representation of Stack and Queue. Doubly linked list: operations. Circular Linked Lists: operations.

UNIT IV TREES (9 Hrs)

Trees: Basic Tree Terminologies. Different types of Trees: Binary Tree – Threaded Binary Tree – Binary Search Tree – Binary Tree Traversals – AVL Tree. Introduction to B-Tree and B+ Tree.

UNIT V SORTING, HASHING AND GRAPHS (9 Hrs)

Sorting: Bubble Sort – Selection Sort – Insertion Sort – Heap Sort – Shell Sort and Radix Sort. Performance and Comparison among the sorting methods. Hashing: Hash Table – Hash Function and its characteristics. Graph: Basic Terminologies and Representations – Graph traversal algorithms.

Text Books

1. Ellis Horowitz, Sartaj Sahni,"Fundamentals of Data Structures", Illustrated Edition, Computer Science Press, 2018.
2. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI, Third Edition, 2010.
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, "Data Structures and Algorithms", 4th Edition, 2009.

Reference Books

1. Balagurusamy, "Data Structures", Tata McGraw-Hill Education, 2019.
2. D.Samanta, "Classic Data Structures, Prentice-Hall of India, Second Edition, 2012.

3. Robert Kruse, C.L. Tondo and Bruce Leung, “Data Structures and Program Design in c”, Prentice-Hall of India, Second Edition, 2007.
4. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Pearson Education, Second Edition, 2006.
5. Mark Allen Weiss, ”Algorithms, Data Structures and Problem Solving with C++”, Addison-Wesley Publishing Company, Illustrated Edition, 1995.

Web References

1. https://www.geeksforgeeks.org/data-structures/
2. https://www.javatpoint.com/data-structure-tutorial/
3. https://www.studytonight.com/data-structures/
4. https://www.tutorialspoint.com/data_structures_algorithms/
5. https://www.w3schools.in/data-structures-tutorial/intro/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-
2	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-
3	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-
5	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20EST358 **ELECTRONIC DEVICES AND CIRCUITS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- Understand the structure of basic electronic devices.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and applications of transistor like BJT and FET.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the structure and working operation of basic electronic devices. **(K1)**

CO2 - Describe the working principle of BJT, FET, UJT and Thyristors. **(K2)**

CO3 - Analyze the behavior of Bipolar Junction Transistors and Field Effect Transistors at different frequency Conditions. **(K3)**

CO4 - Design multistage amplifiers using Bipolar Junction Transistors. **(K4)**

CO5 - Employ the acquired knowledge in design and analysis of oscillators. **(K3)**

UNIT I PN JUNCTION DEVICES (9 Hrs)

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diode characteristics- Zener Reverse characteristics – Zener as a Voltage regulator

UNIT II TRANSISTORS AND THYRISTORS (9 Hrs)

BJT, JFET, MOSFET- structure, operation, Biasing and characteristics. UJT - Characteristics and equivalent circuit – intrinsic standoff ratio –UJT relaxation oscillator, Thyristors- SCR - Two transistor model, DIAC and TRIAC - Operation, Characteristics and their applications.

UNIT III AMPLIFIERS (9 Hrs)

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response. Small signal model of JFET and MOSFET – Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT IV MULTISTAGE AMPLIFIERS (9 Hrs)

RC-coupled amplifier, Operation and Frequency response, Power amplifier – Series fed and transformer coupled Class A amplifiers, Class B amplifier, Circuit and Operation, conversion efficiency, amplifier distortion, Class C and D amplifiers.

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS (9 Hrs)

Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

Text Books

1. A.David, Bell ,"Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
2. Sedra and smith, "Microelectronic circuits",7th Ed., Oxford University Press
3. S.Salivahanan, N. Suresh Kumar, A.Vallavaraj, "Electronic Devices and circuits", Third Edition, Tata McGraw- Hill, 2012

Reference Books

1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition 2014.
2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
4. Robert L.Boylestad, "Electronic devices and circuit theory", 2002.
5. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation" CRC Press, 2004.

Web References

1. https://nptel.ac.in/courses/108/104/108104140/
2. https://nptel.ac.in/courses/108/107/108107128/
3. https://nptel.ac.in/courses/117/103/117103063/
4. https://www.electrical4u.com/diode-working-principle-and-types-of-diode/
5. https://www.allaboutcircuits.com/video-tutorials/transistors/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	1	1	-	-	-	-	1	-	1	2
2	3	1	1	-	1	1	1	-	-	-	-	1	-	1	2
3	3	1	1	-	1	1	1	-	-	-	-	1	-	1	2
4	3	1	1	-	1	1	1	-	-	-	-	1	-	1	2
5	3	1	1	-	1	1	1	-	-	-	-	1	-	1	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20MET305 **MECHANICS OF SOLIDS**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To understand the fundamental concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To compute slopes and deflections in determinate beams by various methods.
- To understand the effect of torsion on shafts and springs
- To learn about the buckling failure in columns and calculate the stresses, deformations induced in thin and thick shells.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Compute the concepts of stress and strain in simple and compound bars and understand the importance of principal stresses and principal planes.**(K2)**

CO2 - Comprehend the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.**(K2)**

CO3 - Calculate the slope and deflection in beams using different methods.**(K3)**

CO4 - Estimate the effect of torsion in shafts and helical spring.**(K3)**

CO5 - Calculate the stresses and strains associated with thin and thick cylinder.**(K3)**

UNIT I STRESSES AND STRAINS (12 Hrs)

Stress and Strain: Basic of stress & strain, Elastic constant, Stress-strain diagram - Hook's law- Factor of safety- stresses and strain in uniformly varying sections- stresses in composite bar- Relation between the modulus and Poisson's ratio – Thermal stresses.

Biaxial state of stress – Stress at a point – stresses on inclined planes – Principal stresses and Principal strains and Mohr's circle of stress.

UNIT II BEAMS AND SIMPLE BENDING (12 Hrs)

Beams: Cantilever, Simply supported: Shear Force and Bending Moment Diagrams. Theory of simple bending – Bending stress and shear stress in beams.

UNIT III DEFLECTION OF BEAMS (12 Hrs)

Deflection of beams: Cantilever and simply supported beam by Double integration method – Macaulay's method – Area moment theorems for computation of slopes and deflections in beams.

UNIT IV TORSION & SPRING (12 Hrs)

Torsion: Introduction - Derivation of torsion equation - stresses and deformations in circular and hollow shafts - Shafts in Series and parallel - Combined bending and torsion- Strain energy due to axial force – Resilience.

Spring: Open and closed coil helical springs, Leaf Springs, Application of Torsion springs.

UNIT V COLUMNS AND CYLINDERS (12 Hrs)

Theory of columns – Long column and short column - Euler's formula – Rankine's formula.

Thin cylinders and shells – Deformation of thin cylinders and shells; Thick Cylinders, Compound Cylinder.

Text Books

1. R.K. Bansal, "Strength of Materials", Laxmi Publications, 6th edition 2019.
2. D.S. Bedi, "Strength of Materials", Khanna Publishing, 6th edition 2019.
3. R.K. Rajput, "Strength of Materials", S. Chand Publications, 7th edition 2018.

Reference Books

1. Punmia, Jain and Jain, "Mechanics of Materials" , Laxmi Publications .2019
2. R.C.Hibbeler, "Mechanics of Materials", Pearson Education, 9th Edition, 2018
3. Egor. P.Popov "Mechanics of Materials" Pearson Education, 2nd Edition, 2016.
4. S.S. Rattan " Strength of Materials" McGraw Hill Education (India) Pvt. Ltd., 3rd Edition, 2016
5. U.C.Jindal., "Strength of Materials", Asian Books Pvt. Ltd., 2nd edition New Delhi, 2018.

Web References

1. https://nptel.ac.in/courses/112107146/#
2. https://nptel.ac.in/courses/112/102/112102284/
3. https://www.iitk.ac.in/me/research/specialization-areas/solid-mechanics-and-design/mechanics-of-solids
4. http://www.facweb.iitkgp.ac.in/~jeevanjyoti/teaching/mechsolids/2019/
5. https://www.coursera.org/courses?query=mechanics%20of%20materials

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1
3	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1
4	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1
5	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20MET306 **COMPUTER AIDED DESIGN**

L	T	P	C	Hrs
3	0	0	3	60

Course Objectives

- To understand the basics of CAD and its applications.
- To gain exposure over the algorithms and transformation techniques used in CAD.
- To learn about the geometric and surface modelling concepts of CAD
- To understand the rendering of models used in various software.
- To understand the standards and database in CAD

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the importance of CAD and its hardware's. **(K2)**
CO2 - Perform transformation techniques and apply algorithm for modifying various CAD drawings. **(K3)**
CO3 - Develop various model using geometric and surface modelling techniques. **(K3)**
CO4 - Illustrate the working of rendering of CAD models. **(K3)**
CO5 - Apply various standards and database models to exchange CAD data models. **(K3)**

UNIT I INTRODUCTION TO CAD AND DISPLAY DEVICES (12 Hrs)

Introduction: Fundamentals of CAD, Design process, Applications of computer for design, Benefits of CAD, Computer peripherals for CAD work station, Graphic terminal, CAD software, CAD database and structure.
Display Devices: Video display devices–Raster scan display, CRT , DVST, Inherent memory display devices, Random Scan Display, Raster scan systems – Video controller, Random scan systems – Graphic monitors and work station, Input devices.

UNIT II TRANSFORMATIONS (12 Hrs)

Bresenham's line and circle algorithms. Transformation in Graphics: co-ordinate system used in Graphics and windowing and view port transformations, Clipping , hidden line elimination, 2D transformations – rotation, scaling, translation, mirror, reflection and shear – homogeneous transformations – concatenation, 3D Transformation – orthographic and Perspective Projections.

UNIT III GEOMETRIC AND SURFACE MODELLING (12 Hrs)

Geometric Modelling: 2D wire frame modelling, 3D Wire frame modelling, Wireframe models, Entities and their definitions. Concept of Parametric and nonparametric representation of curve, Curve fitting techniques, Definitions of cubic splines.
Surface Modelling: Surface modelling and entities, Algebraic and geometric form, Parametric space of Surface, Blending functions, parameterization of surface patch, Subdividing cylindrical surface, Ruled surface, Surface of revolution, Spherical surface, Composite surface.

UNIT IV RENDERING IN CAD (12 Hrs)

Hidden line-surface-solid removal algorithm-shading - colouring-animation Parametric and variational modeling, Feature based modeling, An overview of modeling software like PRO-E, CATIA, IDEAS, SOLID EDGE and other advanced Software's.

UNIT V STANDARDS AND DATABASE IN CAD (12 Hrs)

Standards for computer graphics (GKS) and Data exchange standards – IGES, STEP. Standard for exchange images (open GL) Data structures for Entity storage – Data structures for interactive modelling- Relational databases

Text Books

1. P. Radhakrishnan, S. Subramanyan,V. Raju, "CAD/CAM/CIM", New Age International, 4th Edition, 2020.
2. P.N. Rao, "CAD/CAM: Principles and Applications", Tata McGraw Hill, 3rd Edition, 2010.
3. Ibrahim Zeid and R. Sivasubramaniam, CAD/CAM : Theory and Practice, 2nd Edition, Tata McGraw Hill, 2009

Reference Books

1. Mikell P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, 5th Edition 2019
2. James A. Rehg, Henry W. Kraebber, "Computer Integrated Manufacturing", Pearson Education. 2007
3. Donald Hearn and M.Pauline Baker "Computer Graphics" with OpenGL Prentice Hall, International, 2011
4. Chris McMahon, Jimmie Browne CADCAM: Principles, Practice and Manufacturing Management, 2nd Edition, Pearson publications 1992.

5. Sareen Kuldeep, Grewal Chandandeep, CAD/CAM: Theory and Concept, 2nd Edition, S Chand & Company, 2007.

Web References

1. https://nptel.ac.in/courses/112/102/112102101/
2. http://www.nptelvideos.in/2012/12/computer-aided-design.html
3. https://mech.iitm.ac.in/meiitm/course/cad-in-manufacturing/
4. https://freevideolectures.com/course/2362/computer-aided-design-and-manufacturing
5. https://www.iitk.ac.in/me/me761a

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	-	-	-	-	-	-	-	-	-	3	2	1
2	3	3	2	-	-	-	-	-	-	-	-	-	3	2	1
3	3	3	2	-	-	-	-	-	-	-	-	-	3	2	1
4	3	3	2	-	-	-	-	-	-	-	-	-	3	2	1
5	3	3	2	-	-	-	-	-	-	-	-	-	3	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20MET307 FLUID MECHANICS AND MACHINERY

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To understand the properties of the fluid and flow characteristics.
- To emphasize the concept of dimensional analysis.
- To understand the concept of flow through circular pipes and boundary layer flows.
- To provide knowledge on the working principle and performance curves of hydraulic turbines.
- To educate the working principles and performance analysis of fluid pumps.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the basic fluid property and its application. **(K2)**
CO2 - To apply the concepts of dimensional analysis on the fluid structure. **(K3)**
CO3 - To solve the rate of flow and energy losses in flow through pipes. **(K3)**
CO4 - To evaluate the operating characteristics of hydraulic turbines. **(K3)**
CO5 - Understand the working principles of hydraulic pumps and performances**(K2)**

UNIT I FLUID PROPERTIES AND FLUID STATICS (12 Hrs)

Units and dimensions - Properties of fluids - mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension and capillarity, fluid statics, manometers, Hydrostatic Forces, buoyancy, forces on submerged bodies, stability of floating bodies

UNIT II FLUID KINEMATICS AND FLUID DYNAMICS (12 Hrs)

Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation. Bernoulli's equation, applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis -Buckingham's π theorem applications - similarity laws and models.

UNIT III INCOMPRESSIBLE FLUIDS AND FLOW THROUGH PIPES (12 Hrs)

Viscous flow - laminar flow between parallel plates, - Laminar and Turbulent flow, Reynold's experiment flow through Circular pipes - Darcy - Weisbach equation - friction factor minor losses – flow through pipes in series and in parallel - power transmission - boundary layer flows, boundary layer thickness, boundary layer separation.

UNIT IV HYDRAULIC MACHINE AND TURBINES (12 Hrs)

Principles of Turbo Machinery: Fluid Machines – Classification – Introduction to Impact of jet Stationary plates, Moving Plates and Vanes - Construction of Velocity Vector Diagram– Unit and Specific Quantities. Turbine - Classification – Impulse Turbine – Pelton Wheel – Reaction Turbines – Francis and Kaplan Turbines – Draft Tube Theory – Velocity Triangle – Estimation of force, Power and efficiency – General Characteristics of Turbine – Similarity Study – Governing of Turbine – Cavitation in Turbine.

UNIT V HYDRAULIC PUMPS (12 Hrs)

Classification - Centrifugal Pump – Velocity Triangle – Estimation of Power Required and efficiency – General characteristics - Similarity study – Cavitation in Pump – Reciprocating Pump – Air Vessels – Ideal and Actual Indicator Diagram – Estimation of Power Required, percentage Slip and Efficiency – Cavitation - special purpose pumps.

Text Books

1. R.K.Bansal, "Fluid Mechanics and Hydraulics Machines", Laxmi publications (P) Ltd., New Delhi, 10th Edition, 2018
2. V.L, Streeter and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 9thEdition, 2010.
3. K.L.Kumar, "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, 8thEdition, 2009.

Reference Books

1. S.S.Rattan - Fluid Mechanics and Hydraulic Machines- Khanna Publishers, 2019
2. S.M. Yahya, Turbine, Fans and Compressors, Tata McGraw-Hill- 4th Edition 2017.
3. Yunus Çengel, John M. Cimbala - Fluid Mechanics Fundamentals and Applications-Mc Graw Hill, 4th Edition, 2017
4. F.M.White, "Fluid Mechanics", Tata McGraw-Hill, New Delhi, 8th Edition, 2016.

5. P.N.Modi and S.M.Seth “Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi, 20th Edition, 2015.

Web References

1. https://nptel.ac.in/courses/112/104/112104117/
2. https://nptel.ac.in/courses/112104118/
3. http://fm-nitk.vlabs.ac.in
4. https://www.coursera.org/courses?query=fluid%20mechanics
5. https://apm.iitm.ac.in/fluid_mechanics.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	-	2	2	2
2	3	3	2	3	-	-	-	-	-	-	-	-	2	2	2
3	3	3	2	3	-	-	-	-	-	1	-	1	2	2	2
4	3	3	3	3	-	-	-	-	-	1	-	1	3	3	3
5	3	2	2	3	-	-	-	-	-	1	-	1	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20HSP301

GENERAL PROFICIENCY – I

(Common to all branches except CSBS)

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To enrich strong vocabulary and decoding skills *through comprehension analysis.*
- To advance communication and leadership skills pragmatically.
- To pronounce English sounds in isolation and in connected speech.
- To expand effective written communication skills to meet organizational goals.
- To extend knowledge on verbal aptitude and prepare for interviews.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Interpret *meaning and apply reading* strategies in technical and non-technical context. *(K2)*
CO2 - Develop interpersonal communication skills professionally. *(K3)*
CO3 - Infer the distinct speech sounds and overcome native language influence. *(K2)*
CO4 - Demonstrate various forms of formal writing. *(K2)*
CO5 - Apply the techniques of verbal aptitude in competitive exams. *(K3)*

UNIT I COMPREHENSION ANALYSIS (6 Hrs)

Listening: Listening Comprehension (IELTS based) – Speaking: Break the iceberg - Reading: Reading technical passage (IELTS based) - Writing: Writing Task: 1 (IELTS: Graph/ Process /Chart Description) Vocabulary: Synonyms (IELTS)

UNIT II PERSONALITY DEVELOPMENT (6 Hrs)

Listening: Interview Videos- Speaking: Extempore& Presentation (Soft Skills) - Reading: British & American Vocabulary, Read and review (Books, Magazines) - Writing: SWOT Analysis Vocabulary: Idioms (IELTS)

UNIT III INFERENTIAL LEARNING (6 Hrs)

Listening: Listening Speech sounds to overcome Mother Tongue Influence, Anecdotes– Speaking: Interpersonal Interaction & Situational attribution –Reading: Distinguish between facts & opinions - Writing: Writing Conversation to different context Vocabulary: Phrasal Verbs (IELTS)

UNIT IV INTERPRETATION AND FUNCTIONAL WRITING (6 Hrs)

Listening: Group Discussion videos - Speaking: Group Discussion Practice - Reading: Interpretation of data - Graph, table, chart, diagram (IELTS based) -Writing: Writing Task: 2 (IELTS) Vocabulary: Collocations (IELTS)

UNIT V APTITUDE (6 Hrs)

Language Enhancement: Articles, Preposition, Tenses
Verbal Ability Enhancement: Blood Relation, Completing Statements - Cloze test, Spotting Errors – Sentence Improvement, One Word Substitution, Word Analogy, Word Groups(GATE)

Reference Books

1. Jeff Butterfield, “Soft Skills for Everyone”, Cengage Learning, New Delhi, 2012.
2. Mn,Taylor, and Grant Taylor. “English Conversation Practice”. Tata McGraw-Hill Education, 1975.
3. Bailey, Stephen. “Academic writing: A practical guide for students”. Psychology Press, 2003.
4. Aggarwal, R. S. “A Modern Approach to Verbal & Non Verbal Reasoning”. S. Chand, 2010.
5. Wren, Percival Christopher, and Wren Martin. “High School English Grammar and Composition”. S Chand, 2005.

Web References

1. https://www.ielts-exam.net/grammar/
2. https://ieltsfocus.com/2017/08/02/collocations-ielts/
3. https://www.fresherslive.com/online-test/blood-relations-questions-and-answers
4. https://www.toppr.com/guides/english-language/reading-comprehension/cloze-test/
5. https://www.examsbook.com/word-analogy-test-questions-with-answers

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
2	1	-	-	-	-	-	-	1	-	3	-	1	-	-	1
3	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
4	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
5	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

	DATA STRUCTURES LAB	L	T	P	C	Hrs
U20ESP357	(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL,BME, MECHATRONICS,CCE)	**0**	**0**	**2**	**1**	**30**

Course Objectives

- To understand the basic concepts of Data Structures.
- To learn about the concepts of Searching Techniques.
- To explore about the concepts of Sorting Techniques.
- To know about the linear Data Structures.
- To study about non-linear Data Structures.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Analyze the algorithm's / program's efficiency in terms of time and space complexity.**(K3)**
CO2 - Solve the given problem by identifying the appropriate Data Structure.**(K3)**
CO3 - Solve the problems of searching and sorting techniques. **(K3)**
CO4 - Solve problems in linear Data Structures.**(K4)**
CO5 - Solve problems in non-linear Data Structures. **(K4)**

List of Experiments

1. Write a C program to implement recursive and non-recursive i) Linear search ii) Binary Search.
2. Write a C program to implement i) Bubble sort ii) Selection sort iii) Insertion sort iv) Shell sort v) Heap sort.
3. Write a C program to implement the following using an array. a) Stack ADT b) Queue ADT
4. Write a C program to implement list ADT to perform following operations a) Insert an element into a list. b) Delete an element from list c) Search for a key element in list d) count number of nodes in list.
5. Write a C program to implement the following using a singly linked list. a) Stack ADT b) Queue ADT.
6. Write a C program to implement the dequeue (double ended queue) ADT using a doubly linked list and an array.
7. Write a C program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.
8. Write a C program that use recursive functions to traverse the given binary tree in
   a) Preorder b) Inorder and c) Postorder.
9. Write a C program to perform the AVL tree operations.
10. Write a C program to implement Graph Traversal Techniques.

Reference Books

1. Yashavant Kanetkar, "Data Structures through C", BPB Publications, 3rd edition, 2019.
2. Gav.pai, "Data Structures and Algorithms", McGraw-Hill India, 1st edition, 2013.
3. Manjunath Aradhya M and Srinivas Subramiam, "C Programming and Data Structures", Cengage India 1st edition, 2017.
4. Reema Thareja, "Data structures using C", 2nd edition, Oxford University, 2014.
5. Tenebaum Aaron M, "Data Structures using C', Pearson Publisher, 1st edition, 2019.

Web References

1. https://www.tutorialspoint.com/data_structures_algorithms/
2. https://www.w3schools.in/data-structures-tutorial/intro/
3. https://nptel.ac.in/courses/106103069/
4. https://swayam.gov.in/nd1_noc20_cs70/preview
5. https://nptel.ac.in/courses/106103069/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-
2	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-
3	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-
5	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20MEP302 **MATERIAL TESTING AND METALLURGY LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To make student familiar with modern and conventional tools for material testing.
- To present real world engineering examples of solid mechanics.
- To understand mechanical behavior of various engineering materials by conducting standard tests.
- To perform the characterization of materials like microstructures.
- To learn the concepts of improving the mechanical properties of materials by different methods like heat treatment process.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Evaluate the strength and behavior of materials. **(K3)**
CO2 - Examine the hardness of materials. **(K3)**
CO3 - Develop the theoretical understanding of the mechanical properties of materials. **(K3)**
CO4 - Analysis the procedure of microstructure studies of various materials. **(K3)**
CO5 - Execute the various heat treatment processes for different stages. **(K3)**

List of Experiments

Materials Testing Laboratory

1. Tension test
2. Torsion test
3. Compression test
4. Impact test on a metallic specimen - Izod test
5. Impact test on a metallic specimen - Charpy test
6. Hardness test on metallic specimen - (Brinell, Rockwell)
7. Ductility test: Sheet metals (Al, GI and MS)

Metallurgy Laboratory

8. Identification of the Metals using optical microscope
9. Jominy end quenching test

References Books

1. C.Ravichawla ,Kukreja, K.Kishore, Material Testing Laboratory, by standard publishers, 2016
2. R K Rajput, Engineering Materials and Metallurgy, S. Chand Publishing,2006
3. ASM Handbook Volume 8: Mechanical Testing and Evaluation, Published by ASM International, 2000.
4. A K Bhargava, C P Sharma, Mechanical Behaviour and Testing of Materials by PHI Learning Pvt Ltd, New Delhi, 2014.
5. R Balasubramaniam, Callister Material Science and Engineering, 2nd Edition, Willey Publishers, 2014.

Web References

1. https://virtlabs.tech/strength-of-materials/
2. http://sm-nitk.vlabs.ac.in/index.html
3. https://www.labtesting.com/services/materials-testing/
4. https://nptel.ac.in/courses/112/106/112106293/
5. https://nptel.ac.in/courses/113/107/113107078/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	1	-	-	2	2	1	-	1	3	3	1
2	3	3	2	2	1	-	-	2	2	1	-	1	3	3	1
3	3	3	2	2	1	-	-	2	2	1	-	1	3	3	1
4	3	2	1	2	1	-	-	2	2	1	-	1	3	3	1
5	3	2	1	2	1	-	-	2	2	1	-	1	3	3	1

Correlation Level: 1- Low, 2 - Medium, 3 – High

U20MEP303	FLUID MECHANICS AND MACHINERY LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand the properties of the fluid.
- To impart training to use various flow measuring devices.
- To understand the conservation of laws to flow through pipes.
- To understand the principles and working of hydraulics machines and its applications.
- To provide practice in estimating friction losses.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Analyse and Interpret fluid flow parameters by conducting experiments on venture and orifice experimental setups. **(K3)**

CO2 - Interpret the flow structures through various models. **(K3)**

CO3 - Analyse the performance characteristic of various types of pumps. **(K3)**

CO4 - Correlate the characteristics curves of gear and turbine pump. **(K3)**

CO5 - Evaluate the performance characteristic of various types of turbine. **(K4)**

List of Experiments

1. Evaluate the coefficient of discharge of given Orifice meter.
2. Evaluate the coefficient of discharge of given Venturi meter.
3. Visualizing the flow structures through various models.
4. Conducting experiments and drawing the characteristics curves of centrifugal pump.
5. Conducting experiments and drawing the characteristics curves of submersible pump.
6. Conducting experiments and drawing the characteristics curves of jet pump.
7. Conducting experiments and drawing the characteristics curves of pump in series and parallel.
8. Conducting experiments and drawing the characteristics curves of reciprocating pump.
9. Conducting experiments and drawing the characteristics curves of Gear pump.
10. Conducting experiments and drawing the characteristics curves of Turbine pump
11. Conducting experiments and drawing the characteristics curves of Pelton wheel.
12. Conducting experiments and drawing the characteristics curves of Francis turbine.

Reference Books

1. CWR, Hydraulics Laboratory Manual,2004
2. N. Kumarasamy, Fluid Mechanics and Machinery laboratory manual, Charotar Publishing House Pvt. Ltd. 2008.
3. SC Gupta, Fluid Mechanics and Hydraulic Machines, Pearson Education India, 2006.
4. Modi P.N, & Seth S.M, “Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi, 20th Edition, 2015.
5. White, F.M., “Fluid Mechanics”, Tata McGraw-Hill, New Delhi, 8th Edition, 2016.

Web References

1. http://fmc-nitk.vlabs.ac.in.
2. https://nptel.ac.in/courses/112/103/112103290/
3. https://apm.iitm.ac.in/fluid_mechanics.html
4. https://virtlabs.tech/fluid mechanics/
5. https://www.iitk.ac.in/me/fluid-mechanics-laboratory.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	3	-	-	-	1	-	-	-	2	1	1
2	3	3	2	2	3	-	-	-	1	-	-	-	2	1	1
3	3	3	3	3	3	-	-	-	1	1	1	1	2	1	1
4	3	3	3	3	3	-	-	-	1	1	1	1	2	1	1
5	3	3	3	3	3	-	-	-	1	1	1	1	2	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20BST433

PROBABILITY AND QUEUEING THEORY

(Common to MECH & BME)

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To know the fundamental knowledge of the basic probability concepts.
- To introduce knowledge of standard discrete distributions.
- To acquire knowledge on Probability Distributions.
- To understand strengths and weaknesses of Queuing model.
- To gain strong knowledge in principles of Queuing theory.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the fundamental knowledge of the probability concepts. **(K2)**
CO2 - Apply the basic rules of discrete random variables. **(K3)**
CO3 - Apply the fundamentals of probability theory and random processes. **(K3)**
CO4 - Understand and extend Queuing models to analyze real world systems. **(K2)**
CO5 - Apply the knowledge of Queuing theory in computer field. **(K3)**

UNIT I PROBABILITY AND RANDOM VARIABLE (12 Hrs)

Axioms of probability - Conditional probability - Total probability – Baye's theorem– Moments–Moment generating functions and their properties

UNIT II DISCRETE RANDOM VARIABLES (12 Hrs)

Random Variables and their event spaces, Random variable – Probability mass function – Probability density function - Distribution functions, Binomial - Geometric - Negative Binomial and Poisson.

UNITIII CONTINUOUS RANDOM VARIABLES (12 Hrs)

Some important distributions: Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties – Functions of a random variable.

UNIT IV QUEUING MODELS (12 Hrs)

Markovian queues – Birth and Death processes – Single and multiple server queuing models – Little's formula – Queues with finite waiting rooms – Queues with impatient customers: Balking and reneging.(M/M/I):(∞/FIFO), (M/M/I):(N/FIFO), (M/M/C):(∞/FIFO), (M/M/C):(N/FIFO)

UNIT V ADVANCED QUEUING MODELS (12 Hrs)

Finite source models – M/G/1 queue – PollaczekKhinchin formula – M/D/1 and M/EK/1 as special cases – Series queues – Open Jackson networks.

Text Books

1. N. P. Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.
2. T. Veerarajan, " Probability and Statistics, Random Process and Queuing Theory", McGraw Hill Education, 2018.
3. P. Sivaramakrishna Das, C. Vijayakumari,"Probability and Queuing Theory", Pearson Education, 6th Edition, 2019

Reference Books

1. C. Gupta, B.Shree Ram Singh, M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, New Delhi, 2015
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi,10th Edition, 2019
3. John F. Shortle, James M. Thomson, Donald Gross, "Fundamental of Queuing theory", Wiley series, 5th Edition, 2018
4. M. Bhatt and Ravish R. Singh, "Probability and Statistics", McGraw Hill Education, 2017.
5. P. Kandasamy, K. Thilagavathi and K. Gunavathi, "Probability and Queuing Theory", S. Chand & Co. Pvt. Ltd, 2015.

Web References

1. http://www.maths.qmul.ac.uk/~pjc/notes/prob.pdf
2. https://nptel.ac.in/courses/117/103/117103017/
3. https://youtu.be/COI0BUmNHT8
4. https://nptel.ac.in/courses/111107119/
5. https://youtu.be/Yf3RZ-zW_2M

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	-	-	-	-	-	1	1	1	-
2	3	2	1	1	-	1	-	-	-	-	-	1	1	1	-
3	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-
4	2	1	-	-	-	1	-	-	-	-	-	1	3	3	-
5	3	2	1	1	-	1	-	-	-	-	-	1	3	2	

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20EST467 **PROGRAMMING IN JAVA**
(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHTRONICS, CCE)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To gain and explore the knowledge of java programming
- To know the principles of inheritances, packages, interfaces
- To get familiarized to generic programming, multithreading concepts.
- To gain and explore the advanced concepts in Java.
- To explore database connectivity

Course Outcomes

After completion of the course, the students will be able to

CO1 - Write a maintainable java Program for a given algorithm and implement the same. **(K2)**
CO2 - Demonstrate the use of inheritance, interface and package in relevant applications. **(K3)**
CO3 - Create java applications using exception handling, thread and generic programming. **(K3)**
CO4 - Build java distributed applications using Collections and IO streams. **(K3)**
CO5 - Exemplify simple graphical user interfaces using GUI components and database programs. **(K3)**

UNIT I INTRODUCTION TO JAVA PROGRAMMING (9 Hrs)

The History and Evolution of Java – Byte code – Java buzzwords – Data types – Variables – Arrays – operators – Control statements – Type conversion and casting. Concepts of classes and objects: Basic Concepts of OOPs – constructors – static keyword – Final with data – Access control – This key word – Garbage collection – Nested classes and inner classes – String class

.

UNIT II INHERITANCE, PACKAGES AND INTERFACES (9 Hrs)

Inheritance: Basic concepts – Forms of inheritance – Super key word – method overriding – Abstract classes – Dynamic method dispatch – The Object class. Packages: Defining – Creating and Accessing – importing packages. Interfaces: Defining – Implementing – Applying – Variables and extending interfaces

UNIT III EXCEPTION HANDLING, MULTITHREADING (9 Hrs)

Concepts of Exception handling – Types of exceptions – Creating own exception – Concepts of Multithreading – creating multiple threads – Synchronization – Inter thread communication. Enumeration: Autoboxing – Generics.

UNIT IV COLLECTIONS, I/O STREAMS (9 Hrs)

Collections: List – Vector – Stack – Queue – Dequeue – Set – Sorted Set. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.

UNIT V EVENT DRIVEN PROGRAMMING AND JDBC (9 Hrs)

Events – Delegation event model – Event handling – Adapter classes. AWT: Concepts of components – Font class – Color class and Graphics. Introduction to Swing: Layout management - Swing Components. Java Database Connectivity. Develop real time applications.

Text Books

1. Herbert Schildt, Java: The Complete Reference 11th Edition, TMH Publishing Company Ltd, 2018.
2. Sagayaraj, Denis, Karthik, Gajalakshmi , “JAVA Programming for core and advanced learners” , Universities Press Private Limited, 2018
3. Herbert Schildt, “The Complete Reference JAVA 2”, TMH, Seventh Edition, 2006.

Reference Books

1. H.M.Dietel and P.J.Dietel, “Java How to Program”, 11th Edition, Pearson Education/PHI, 2017.
2. Nageshvar rao, “Core Java and Integrated Approach”, 1st Edition, Dreamtech, 2016.
3. Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, Prentice Hall, 9th Edition, 2013.
4. P.J. Dietel and H.M Dietel, “Java for Programmers”, Pearson Education, 9th Edition, 2011.
5. Cay.S.Horstmann and Gary Cornell, “Core Java 2”, Pearson Education, 8th Edition, 2008.

Web References

1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/.
3. IBM’s tutorials on Swings, AWT controls and JDBC.

4. https://www.edureka.co/blog
5. https://www.geeksforgeeks.org

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	-	-	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	-	1	1
3	3	2	1	1	3	-	-	-	-	-	-	-	-	1	1
4	3	2	1	1	3	-	-	-	-	-	-	-	-	1	1
5	3	2	1	1	3	-	-	-	-	-	-	-	-	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20MET408 **KINEMATICS OF MACHINERY**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To understand the basics components and layout of linkages in the assembly of a system and machine to visualize simple mechanisms and its applications
- To Illustrate students about Kinematic Analysis (Instantaneous center method and relative velocity method) of simple mechanisms
- To provide students an understanding of different types of mechanisms.
- To teach students about different types of specified contour and derived contour cams and its kinematic analyses.
- To explain about kinematic advantages, problems and explain about epicyclic gear train and its speed calculation.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Demonstrate an understanding of the concepts of various mechanisms and pairs. **(K2)**
CO2 - Solve velocity and acceleration in simple mechanism by Graphical Method. **(K3)**
CO3 - Develop a simple mechanism such as Four Bar and slider crank Mechanism. **(K4)**
CO4 - Design a layout of cam for specified motion. **(K4)**
CO5 - Solve problem on gears and gear Train. **(K4)**

UNIT I BASICS OF MECHANISMS (12 Hrs)

Mechanisms and machines; Elements of kinematic chain, mobility and range of movements, Definition & Concept - inversion of single and double slider chain and four bar chain and its applications Mechanism with lower pairs -Pantograph, Straight line mechanism- exact and approximate Motion-Mini projects.

UNIT II KINEMATIC ANALYSIS OF MECHANISMS (12 Hrs)

Analysis of displacement, velocity & acceleration diagrams of simple planar mechanisms by graphical (Instantaneous center method and relative velocity method), analytical and computer aided methods (for four-bar and slider crank mechanism only.

UNIT III KINEMATIC SYNTHESIS OF MECHANISMS (12 Hrs)

Kinematic synthesis, graphical method using relative pole method, Inversion method and overlay 3 point synthesis problems - Motion, path & function generation, Chebyshev's spacing of accuracy points -Freudenstein Method of 3 point synthesis of four link mechanism and slider crank Mechanism- Coupler curves.

UNIT IV CAMS (12 Hrs)

Classification-Displacement diagrams-Uniform velocity, SHM, uniform acceleration and retardation and cycloidal motions-layout of profile of plate cams of the above types with reciprocating, oscillating, knife edge, roller and flat faced followers.

UNIT V GEARS AND GEAR TRAIN (12 Hrs)

Classification and terminology used Fundamental law of gearing – friction wheel, teeth for positive action and condition for constant velocity ratio. Conjugate profiles cycloidal and involute teeth profiles. Involute construction, properties and computation of path of contact and contact ratio. Interference and undercutting- Minimum number of teeth to avoid Interference, methods to avoid Interference. Introduction, classification, examples, gear ratio in simple and compound gear trains.

Text Books

1. S S.Rattan - Theory of Machines, McGraw Hill, 5th Edition, 2019
2. J.J. Uicker, Jr., G.R. Pennock, and J.E. Shigley - Theory of Machines and Mechanisms, Oxford University Press, 5th Edition, 2016
3. Amitabh Ghosh, Ashok Kumar Malik - Theory of Mechanisms and Machines, Edition, 3. Publisher Affliated East, 1998.

Reference Books

1. Brian W. Kernighan & Dennis Ritchie. “The C Programming Language”, Second Edition, Pearson Education India, 2015`
2. J.S.Rao and R.V.Dukkipati - Mechanism and Machine Theory, New Age International, 2014.
3. P.L. Ballaney - Mechanics of Machines, Khanna Publishers, 2012
4. Thomas Bevan - Theory of Machines, 3rd Edition, Pearson education, 2009
5. R.S.Khurmi, Gupta,.J.K., “Theory of Machines”, S.Chand & Company, 2009

Web References

1. http://mm-nitk.vlabs.ac.in/
2. https://nptel.ac.in/courses/112104114
3. https:/ ocw.mit.edu
4. https://easyengineering.net/me6401-kinematics-of-machinery/
5. https://link.springer.com/book/10.1007/978-94-007-1156-3

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20MET409 **HEAT AND MASS TRANSFER**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To understand the conduction type of heat transfer in steady and transient condition.
- To enable the students to expose the mechanisms of free and forced convection type of heat transfer.
- To develop the radiation shape factor for black and grey body radiations.
- To demonstrate the phase change heat transfer and calculate the performance of heat exchanging devices.
- To provide the knowledge on diffusion and convective mass transfer.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the basic concepts of heat transfer and solve steady and unsteady conduction heat transfer problems. **(K2)**

CO2 - Determine the temperature variation and rate of heat flow in convection heat transfer problems. **(K4)**

CO3 - Explain basic laws for Radiation and Determine the radiation properties of a black and grey body Radiation**. (K2)**

CO4 - Integrate the concepts of phase change heat transfer and compare the thermal performance of heat exchangers using LMTD and NTU approach. **(K5)**

CO5 - Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications. **(K3)**

UNIT I CONDUCTION (12 Hrs)

Introduction of heat transfer – conduction - convection and radiation – Laws – General equation of heat conduction – Derivation in Cartesian - cylindrical and spherical coordinates – One dimensional steady state heat conduction in simple geometries – plane wall - cylinder and sphere – Heat transfer composite walls - composite cylinders and composite spheres – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.

UNIT II CONVECTION (12 Hrs)

Boundary layer theory – Hydrodynamic and Thermal Boundary Layer- Dimensional Analysis-Flow over a flat– Flow over cylinders -spheres - tube bank – Internal flow through pipes in forced heat transfer – Natural convection in vertical - inclined and horizontal surfaces – Mixed convection.

UNIT III RADIATION (12 Hrs)

Radiation heat transfer –Thermal radiation – Laws of radiation – Black body concept – Grey body radiation - Emissive power – Radiation shape factor-radiation heat exchange between surfaces – Electrical Analogy – Radiation Shields-Radiation through gases.

UNIT IV PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS (12 Hrs)

Condensation and Boiling – Film wise and drop wise condensation – Film condensation on a Vertical plate – Regimes of Boiling – Forced convection boiling. Heat Exchangers – Types and practical applications – Use of LMTD – Effectiveness – NTU method – Compact heat exchangers – Plate heat exchangers – Fouling factor.

UNIT V MASS TRANSFER (12 Hrs)

Introduction of Mass Transfer – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy –Convective Mass Transfer Correlations-Evaporation of water into air.

Text Books

1. R. C. Sachdeva, Fundamentals of Heat and Mass Transfer, New Age International Publishers, 2017.
2. C. P. Kothandaraman and S. Subramanyan, Fundamental of Heat and Mass Transfer, New Age International Publishers, 2012.
3. P. K. Nag, Heat and Mass Transfer, McGraw Hill Education India Pvt. Ltd. 2011.

References Books

1. C. P. Kothandaraman and S. Subramanyan, Heat and Mass Transfer Data Book, Fifth Edition, New Age International Publishers, 2018.

2. P.Frank, Incropera and David P. Dewitt, Incropera's principles of Heat and Mass Transfer, Wiley India Edition, 2018
3. A.Yunus, Cengel, Heat and Mass Transfer: Fundamentals and Applications, McGraw Hill Education, 2016.
4. P. S. Ghoshdastidar, Heat Transfer, Oxford University Press. 2012
5. J. P. Holman, Heat Transfer, 10th Edition, McGraw-Hill Publishing Company Limited. 2011

Web References

1. https://nptel.ac.in/courses/112108149
2. https://nptel.ac.in/courses/112106170
3. https://nptel.ac.in/courses/112105248
4. http://ceng.tu.edu.iq/ched/images/lectures/chem-lec/st3/c3/Lectures-Mass%20Transfer-1.pdf
5. http://www.ht.energy.lth.se/fileadmin/ht/Kurser/MMV031/Introduction-HEX.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	2	2	2	3
2	3	2	2	1	1	-	-	-	-	-	-	2	2	2	3
3	3	2	2	1	1	-	-	-	-	-	-	2	2	2	3
4	3	3	3	2	2	-	-	-	-	-	-	2	3	3	3
5	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20HSP402	GENERAL PROFICIENCY – II (Common to all branches except CSBS)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To examine various standardized test in English language
- To recognize the key features of various technical writing
- To integrate LSRW skills to endorse multifarious skill set in practical situation
- To understand the factors that influence the usage of grammar
- To understand the basic concepts of logical reasoning skills

Course Outcomes

After completion of the course, the students will be able to

CO1 - *Infer ideas to attend international standardized test by broadening receptive and productive skills.* **(K2)**

CO2 - *Interpret the types of writing in different state of affairs.* **(K2)**

CO3 - *Develop language skills professionally to groom the overall personality through sensitizing various etiquettes in real time situation.* **(K3)**

CO4 - *Identify the rules of grammar in academic discourse settings.* **(K3)**

CO5 - *Extend the skills to compete in various competitive exams like GATE, GRE, CAT, UPSC, etc.* **(K2)**

UNIT I CAREER SKILLS (6 Hrs)

Listening: Listening at specific contexts Speaking: Mock interview (Personal & Telephonic) - Reading: Read and Review - Newspaper, Advertisement, Company Handbooks, and Guidelines (IELTS based) Writing: Essay Writing (TOEFL) Vocabulary: Words at specified context (IELTS)

UNIT II CORPORATE SKILLS (6 Hrs)

Listening: Listening and replicating Speaking: Team Presentation (Work Place Etiquettes) Reading: Short texts (signs, emoticons, messages) Writing: E-mail writing- Hard skills -Resume' Writing, Job Application Letter, Formal Letter Vocabulary: Glossary (IELTS)

UNIT III FUNCTIONAL SKILLS (6 Hrs)

Listening: Listening TED Talks – Speaking: Brainstorming &Individual Presentation, Persuasive Communication –- Reading: Text Completion (GRE Based) Writing: Expansion of Compound Words Vocabulary: Expansion of vocabulary (IELTS)

UNIT IV TRANSFERABLE SKILLS (6 Hrs)

Listening: Listening Documentaries and making notes – Speaking: Conversation practice at formal & informal context Reading: Read and transform- report, memo, notice and advertisement, Writing: Euphemism, Redundancy, and Intensifiers Vocabulary: Refinement of vocabulary (IELTS)

UNIT V APTITUDE (6 Hrs)

Transformational Grammar: Phrases & Clauses, Concord, Conditional Clauses, Voice, Modals.
Verbal Ability Enhancement: Letter Series, Coding and Decoding, Sentence Completion (GATE), Critical Reasoning and Verbal Deduction (GATE), Syllogism.

Reference Books

1. Lougheed, Lin. "Barron's Writing for the TOEFL IBT: With Audio CD". Barron's Educational series, 2008.
2. Tulgan, Bruce**.** "Bridging the soft skills gap: How to teach the missing basics to today's young talent". John Wiley and Sons, 2015.
3. Sherfield, Robert M. "Cornerstone: Developing Soft Skills". Pearson Education India, 2009.
4. Cullen, Pauline, Amanda French, and Vanessa Jakeman**.** "The official Cambridge guide to IELTS for academic and general training".Cambridge, 2014.
5. Ramesh, Gopalaswamy. "The ace of soft skills: attitude, communication and etiquette for success". Pearson Education India, 2010.

Web References

1. https://www.englishclub.com/grammar/nouns-compound.htm
2. https://lofoya.com/Verbal-Test-Questions-and-Answers/Sentence-Completion/l3p1
3. https://www.grammarwiz.com/phrases-and-clauses-quiz.html
4. https://www.clarkandmiller.com/25-english-euphemisms-for-delicate-situations/
5. http://www.englishvocabularyexercises.com/general-vocabulary/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	1	-	3	-	1	-	-	-
2	1	-	-	-	-	-	-	1	-	3	-	1	-	-	1
3	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
4	1	-	-	-	-	-	-	1	-	3	-	1	-	-	1
5	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20ESP468

PROGRAMMING IN JAVA LAB

(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHATRONICS, CCE)

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To acquire programming skill in core java.
- To learn how to design java program and applications.
- To acquire object oriented skills in java.
- To develop the skill of designing applications.
- To explore database connectivity.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Apply and practice logical formulations to solve simple problems leading to specific applications. **(K3)**
CO2 - Demonstrate the use of inheritance, interface and package in relevant applications. **(K3)**
CO3 - Create java applications using exception handling, multithread. **(K3)**
CO4 - Build java distributed applications using Collections and IO streams. **(K3)**
CO5 - Develop simple database programs. **(K3)**

List of Exercises

1. Develop simple programs using java technologies and testing tools.
2. Develop a java program that implements class and object.
3. Write a java program to demonstrate inheritance.
4. Develop a simple real life application program to illustrate the use of Multi Threads.
5. Implement simple applications using Collections.
6. Develop a simple application and use JDBC to connect to a back-end database.
7. Create a student application with Add, Edit, Delete, Show functions using JDBC.
8. Create a Bill Application to store sales details using JDBC.
9. Create java applications using Exception Handling for error handling.
10. Develop a java program that implements the Packages.

Reference Books

1. E. Balagurusamy, “Programming with java”, TMH Publication, 2nd Edition, 2005.
2. JAVA How to programming by DIETEL and DIETEL.
3. Herbert Schildt, “The Complete Reference JAVA 2”, TMH, Seventh Edition, 2006.
4. Cay .S.Horstmann and Gary Cornell, “Core Java 2”, Vol 2, Advanced Features, Pearson Education, Seventh Edition, 2010.
5. Sagayaraj, Denis, Karthik, Gajalakshmi, “JAVA Programming for core and advanced learners”, Universities Press Private Limited, 2018.

Web References

1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/.
3. IBM’s tutorials on Swings, AWT controls and JDBC.
4. https://www.edureka.co/blog
5. ttps://www.geeksforgeeks.org.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	-	-	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	-	1	1
3	3	2	1	1	3	-	-	-	-	-	-	-	-	1	1
4	3	2	1	1	3	-	-	-	-	-	-	-	-	1	1
5	3	2	1	1	3	-	-	-	-	-	-	-	-	1	1

Correlation Level: 1- Low, 2 - Medium, 3 – High

U20MEP404 **COMPUTER AIDED MACHINE DRAWING LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To expose the students to CAD /CAE software in the design and drawing of machine components
- To create assembly models of simple machine elements
- To draw various permanent and temporary joints
- To read and interpret the diagrams drawn by draughtsman by familiarizing on GD&T
- To familiarize on analysis of engineering drawing

Course Outcomes

After completion of the course, the students will be able to

CO1 - Design and drawing of machine using suitable software. **(K3)**
CO2 - Draw 2D Assembly models of simple machine elements. **(K3)**
CO3 - Draw various joints using in machine assembly. **(K3)**
CO4 - Apply the concept of GD&T in drawings. **(K3)**
CO5 - Analyze the drawings using engineering skills. **(K4)**

List of Experiments

1. Preparation of Drawings for Parts and Assembly of the following by using Drafting software.
   Gear coupling, spring loaded safety valve, lever safety valve, blow-off cock, cast iron flange joint, hydraulic joint, feed check valve, foot step bearing, ball valve, stuffing box- minimum 5 exercises
2. Preparation of Production Drawings with tolerances limits and fits using Drafting software - Minimum 1 exercise
3. Introduction to Geometric Dimensioning and Tolerancing, Geometric Tolerances Symbols- Tolerance Zone, Run-out, Feature Control Frame and its components, Straightness, Flatness, Circularity and Cylindricity, Parallelism, Perpendicularity and Angularity, Material Conditions- MMC and LMC, Position Tolerance & Datums, Twelve Degrees of Freedoms & Datum Planes, Surface Symbols – Roughness- Applying Feature Control Frame usage in drawings - minimum 5 exercises

References/ Manuals/ Software

1. Ajeet Singh, Machine Drawing, Tata McGraw-Hill Publishing Company, New Delhi, 2nd Edition, 2012.
2. Bhatt.N.D. “Machine Drawing”, Charotar Publishing House, 50th Edition, 2016.
3. Narayana, K.L., Bheemanjaneyulu, S, "Engineering Drawing with AutoCAD 2016", New Age International, 1st Edition, 2018.
4. K.Venugopal, V. Prabhu Raja, "Engineering Drawing + AutoCAD", New Age International 5th Edition, 2011.
5. Goutam Pohit, Goutam Ghosh, Machine drawing with AutoCAD, Pearson Education, 1st Edition, 2007.
6. P.S. Gill, Geometric Dimensioning and Tolerancing, S. K. Kataria & Sons, 2009.

Web References

1. https://mech.iitm.ac.in/Production%20Drawing.pdf
2. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/egraphics_lab/labs/index.php
3. http://www.nptelvideos.in/2012/12/computer-aided-design.html
4. https://autocadtutorials.com
5. https://dwgmodels.com

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	-	-	-	-	-	-	-	1	2	2	3
2	3	2	2	1	-	-	-	-	-	-	-	1	2	2	3
3	3	2	2	1	-	-	-	-	-	-	-	1	2	2	3
4	3	2	2	1	-	-	-	-	-	-	-	1	2	2	3
5	3	2	2	1	-	-	-	-	-	-	-	1	2	2	3

Correlation Level: 1- Low, 2 - Medium, 3 – High

U20MEP405 **HEAT TRANSFER LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To define the fundamental concepts in the area of heat transfer and its applications.
- To recognize the practical significance of various parameters involved with different modes of heat transfer.
- To apply conduction and convection mode of heat transfer with heat transfer equipment.
- To understand radiation heat transfer concept to find Stefan Boltzmann constant and emissivity.
- To teach the principle of parallel flow, Counter flow and Plate type heat exchangers

Course Outcomes

After completion of the course, the students will be able to

CO1 - Analyse and Interpret heat transfer parameters by conducting experiments on conduction and convection experimental set-up**. (K4)**

CO2 - Analyse and Interpret heat transfer parameters by conducting experiments on radiation experimental set-up**. (K4)**

CO3 - Analyse and Interpret heat transfer parameters by conducting experiments on Heat exchanger experimental set-up**. (K4)**

CO4 - Analyse and Interpret the surface emissivity of a test plate and Stefan Boltzmann's constant and compare with theoretical value**. (K4)**

CO5 - Analyse and Interpret the thermal conductivity and transient heat conduction experiments**. (K4)**

List of Experiments

1. Heat transfer on cylindrical surface by natural convection
2. Heat transfer on cylindrical surface by forced convection
3. Heat transfer from Pin fin by natural convection.
4. Heat transfer from Pin fin by forced convection.
5. Heat transfer on a composite wall.
6. Experiment to evaluate Stefan Boltzmann constant.
7. Experiment to evaluate the emissivity of a specimen.
8. Experiment on Parallel flow heat exchanger
9. Experiment on Counter flow heat exchanger
10. Experiment on plate type heat exchanger

Reference Books

1. C. P. Kothandaraman and S. Subramanyan, Heat and Mass Transfer Data Book, Fifth Edition, New Age International Publishers, 2018.
2. R. C. Sachdeva, Fundamentals of Heat and Mass Transfer, New Age International (P) Ltd, 2017.
3. J. P. Holman, Heat Transfer, 9th Edition, McGraw-Hill Publishing Company Limited, 2011.
4. S.P. Sukhatme, A text book on Heat Transfer, Fourth Edition, Universities Press, 2005.
5. C. A. Sundén, Brebbia, Heat Transfer XIII Simulation and Experiments in Heat and Mass Transfer, WIT Press, 2013.

Web References

1. http://htv-au.vlabs.ac.in/
2. https://nptel.ac.in/courses/103/103/103103032/
3. https://nptel.ac.in/courses/112/101/112101097/
4. https://www.iitk.ac.in/me/heat-transfer-laboratory
5. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Mechanical/Heat%20and%20Mass%20Transfer/TOC.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	2
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	2
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2	2
4	3	3	3	2	2	-	-	-	-	-	-	1	3	3	3
5	3	2	2	1	1	-	-	-	-	-	-	1	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVES - I

		L	T	P	C	Hrs
U20MEE401	**GAS DYNAMICS AND JET PROPULSION**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand the basic difference between incompressible and compressible flow.
- To analyze the effect of Mach number on compressibility.
- To examine the flow properties in variable area and constant area ducts.
- To understand the phenomenon of shock waves and its effect on flow.
- To understand the basic knowledge about jet propulsion and rocket propulsion system.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the basic concepts of compressible fluid flows. **(K1)**
CO2 - Describe the behaviour of fluid flow in constant area ducts. **(K1)**
CO3 - Interpret the equations governing normal shock. **(K2)**
CO4 - Define the performance metrics of turbo jet, ram jet and pulse jet engines. **(K3)**
CO5 - Explain the basics of rocket propulsion systems. **(K1)**

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS (9 Hrs)

Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility- Isentropic flow through variable ducts – Nozzle and Diffusers Use of Gas tables.

UNIT II FLOW THROUGH DUCTS (9 Hrs)

Flow in constant area ducts with friction (Fanno flow) - Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length. Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer- Applications.

UNIT III NORMAL SHOCK (9 Hrs)

Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shock, Prandtl – Meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock- Use of tables and charts.

UNIT IV JET PROPULSION (9 Hrs)

Theory of jet propulsion – types of jet engines – study of turbojet engine components – diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of jet engines – thrust, thrust power, propulsive and overall efficiencies.

UNIT V SPACE PROPULSION (9 Hrs)

Theory of rocket propulsion -types of rocket engines – Propellants-feeding systems – Ignition and combustion – rocket engines thrust equation – effective jet velocity specific impulse – rocket engine performance – Staging – Terminal and characteristic velocity – Applications – space flights.

Text Books

1. J.D.Anderson, "Modern Compressible flow: With historical perspective", 3rd Edition, McGraw Hill, 2017.
2. S.M.Yahya, "Fundamentals of Compressible Flow with aircraft and rocket propulsion", New Age International Publisher, New Delhi, 2018.
3. H.Cohen, G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Pearson, 2019.

Reference Books

1. V.Ganesan, "Gas Turbines", Tata McGraw Hill, 2010.
2. P.H. Oosthvizen, William E.Carscallen, “Introduction of Compressible fluid flow”, CRC press, 2013.
3. E. Rathakrishnan, “Gas Dynamics”, Prentice Hall of India, New Delhi, 2014.
4. V.Babu “Fundamentals of Gas Dynamics”, Wiley, 2015.
5. S.M.Yahya, "Gas tables: For compressible flow calculation”, New Age International Publisher,New Delhi, 2018.

Web References

1. https://nptel.ac.in/courses/112106166/
2. https://nptel.ac.in/courses/101101002/
3. https://nptel.ac.in/courses/112103021/
4. http://www.infocobuild.com/education/audio-video-courses/mechanical-engineering/GasDynamics Propulsion- IIT-Madras/lecture-21.html
5. Jet Propulsion -https://www.youtube.com/watch?v=cOk4-nKRhr8- nptl

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	-	-	-	-	-	-	-	-	1	2	1
2	3	2	1	1	-	-	-	-	-	-	-	-	1	2	1
3	3	2	1	1	-	-	-	-	-	-	-	-	1	2	1
4	3	2	1	1	-	-	-	-	-	-	-	-	1	2	1
5	3	2	1	1	-	-	-	-	-	-	-	-	1	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20MEE402 **GEOMETRIC TOLERANCE AND DIMENSIONING**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand Geometric Dimensioning and Tolerance standards to communicate design Intent.
- To Learn how the dimensioning and tolerance can affect part design and documentation
- To Learn Symbols, Geometric Characteristic of dimension
- To understand how dimensional variation can affect a design.
- To Gain added insight on working in a team design environment.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the geometrical requirements on engineering drawings. **(K1)**
CO2 - Interpret and specify dimensions and tolerance in professional manner. **(K3)**
CO3 - Explain geometric symbols and rules. **(K1)**
CO4 - Specify straightness, circularity and cylindricity tolerance. **(K3)**
CO5 - Define the orientation and profile of plane surfaces. **(K1)**

UNIT I INTRODUCTION TO GEOMETRIC DIMENSIONING AND TOLERANCE (9 Hrs)

Geometric product definitions principles , Geometric characteristics symbols, Chart symbols, Rules sheet, introduction to Geometric Tolerance, Coordinate tolerance, Geometric dimensioning, , Allowance and Clearance, GT & D Terms, GT & D rules, Concepts, Value of Tolerance, flat tolerance, straight tolerance, circularity and cylindricity tolerance.

UNIT II DIMENSIONING AND TOLERANCE FUNDAMENTALS (9 Hrs)

Fundamental Drawing Rules, Units of Linear Measurement, Specifying Linear Dimensions, Specifying Linear Tolerances, Interpreting Dimensional Limits, Specifying Angular Dimensions, Specifying Angular Tolerances, Dimensioning and Tolerancing for CAD/CAM Database Models.

UNIT III SYMBOLS, TERMS AND RULES (9 Hrs)

Symbols, Geometric Characteristic Symbols, Datum Feature Symbol, Feature Control Frame, Reading the Feature Control Frame, Other Symbols Used with Geometric Tolerancing, Terms, Rules, Limits of Size Prescribe Variations of Form, Applicability of Modifiers in Feature Control Frames, Pitch Diameter Rule.

UNIT IV FLATNESS AND STRAIGHTNESS (9 Hrs)

Definition, Specifying Straightness of Surface Tolerance, Specifying Straightness of Median Line, Circularity: Definition, Specifying Circularity Tolerance, Cylindricity: Definition, Specifying Cylindricity Tolerance, Free-State Variation- Problems.

UNIT V ORIENTATION, POSITION, LOCATION AND PROFILE (9 Hrs)

Definition, Specifying Perpendicularity of a Flat Surface, Tangent Plane, Specifying the Perpendicularity of an Axis to a Plane Surface, Parallelism, Angularity, Floating Fasteners, Fixed Fasteners, Projected Tolerance Zones, Multiple Patterns of Features, Specifying Profile Tolerance, Application of Datum Features, A Radius Refinement with Profile, Combining Profile Tolerances with other Geometric Controls.

Text Books

1. P.S.Gill, Geometric Dimensioning & Tolerancing,S. K. Kataria and Sons, 2009.
2. Alex Krulikowski, Fundamentals of Geometric Dimensioning and Tolerance, Cengage Learning, 2012.
3. Gene Cogorno, Geometric Dimensioning and Tolerancing for Mechanical Design 2/E, McGraw-Hill Professional, 2011.

Reference Books

1. Gene R. Cogorno, Geometric Dimensioning and Tolerancing for Mechanical Design, 3E, McGraw Hill Professional, 2020
2. David A. Madsen, Geometric Dimensioning and Tolerancing, Goodheart-Willcox Company, 2010
3. G.Henzold, Handbook of Geometrical Tolerancing: Design, Manufacturing and Inspection, 1995.
4. Paul J. Drake, Dimensioning and Tolerancing Handbook, McGraw-Hill Professional, 1999.
5. James D. Meadows, Geometric Dimensioning and Tolerance, Routledge, 2017.

Web References

1. https://www.fictiv.com/articles/gdt-101-an-introduction-to-geometric-dimensioning-and-tolerancing
2. https://formlabs.com/blog/gdt-geometric-dimensioning-and-tolerancing/
3. https://www.gdandtbasics.com/
4. https://www.youtube.com/watch?v=aS9OgYadjpY
5. https://www.youtube.com/watch?v=fXoWTHwElvo

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	1	-	-	-	-	-	-	-	-	1	-	1	1
2	2	-	1	-	2	-	-	-	-	-	-	1	-	1	2
3	2	-	1	-	2	-	-	-	-	-	-	1	-	1	2
4	2	-	1	-	2	-	-	-	-	-	-	1	-	1	2
5	2	-	1	-	2	-	-	-	-	-	-	1	-	1	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20MEE403 **PRODUCT DESIGN AND DEVELOPMENT**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To study the basic concepts of product design and features.
- To understand the quality function deployment tool for identifying customer needs.
- To demonstrate knowledge of Brain dominance theory.
- To understand the approach of material selection for design.
- To get the knowledge about problem solving tools and codes.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain conceptual product design techniques. **(K1)**
CO2 - Identify Customer needs and products design specifications. **(K1)**
CO3 - Use different systematic concept generation techniques in product design. **(K3)**
CO4 - Use the embodiment design principles for environment aware design. **(K3)**
CO5 - Solve ethical conflicts and issues in engineering environment. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Design versus Scientific method, Considerations of a Good Design, Product Development process cycles, Organizations for Product Design, Technological Innovation and Business Strategies, Modern Product development and design theories, Reverse engineering and redesign methodology.

UNIT II PROBLEM DEFINITION (9 Hrs)

Identifying Customer needs, Kano Diagram, Establishing Engineering Characteristics, Quality Function Deployment (QFD), Product Design Specification (PDS) Design information and sources, Professional societies and Trade associations, Codes and Standards, Patents and Intellectual Property

UNIT III CONCEPT GENERATION (9 Hrs)

Freud's model, Brain dominance theory, Creative thinking techniques and barriers, Systematic methods: Tear down and experimentation, Function structure, Morphological methods, Theory of Inventive Problem solving (TRIZ), Axiomatic Design (AD) Decision Theory, Evaluation methods, Comparison based on absolute criteria, Pugh's concept, Measurement scales, Weighted decision Matrix, Analytic Hierarchy process (AHP).

UNIT IV EMBODIMENT DESIGN (9 Hrs)

Product Portfolios and Architecture, Configuration and Parametric design, detailed design, Ergonomics and Design for Environment, Modeling and Simulation, Material selection for Design, Quality assessment and Robust Design.

UNIT V TOOLS AND ETHICAL ISSUES IN ENGINEERING (9 Hrs)

Team Roles and Dynamics, Effective Team meeting, Robert rules and Parliamentary procedures, Problem solving tools, planning and scheduling, Time management. Origin of laws, Contracts, Product Liability, Tort Law, Codes of Ethics, and solving ethical conflicts.

Text Books

1. George E Dieter, Engineering Design 3rd Edition McGraw Hill, 2001.
2. Karl T. Ulrich, Product Design and Development, Tata McGraw Hill International, 2003.
3. G. Lawrence Sanders, Developing New Products and Services, Publisher: Saylor Foundation2013

Reference Books

1. Ken Hurst, Engineering Design Principles, Elsevier, 1999.
2. Otto, Product Design, Pearson Education India, 2001.
3. Pahl, W Beitz J Feldhusun, K G Grote, Engineering Design, 3rd Edition, Springer, 2007.
4. Sven G. Bilén, Introduction to Engineering Design, McGraw Hill Learning Solutions, 2008.
5. Steven Eppinger, Karl Ulrich, Product Design and Development McGraw-Hill Higher Education, 2015.

Web References

1. https://www.digimat.in/nptel/courses/video/112107217/L01.html
2. https://nptel.ac.in/courses/112/104/112104230/
3. http://www.nptelvideos.com/lecture.php?id=15953

4. https://cosmolearning.org/video-lectures/mod-4-lec-14-product-design-development-8953/
5. https://www.udemy.com/course/product-design/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	-	-	-	-	-	-	-	-	-	1	2	1	2
2	2	2	2	2	2	-	-	-	-	-	-	1	2	2	2
3	2	2	2	2	2	-	-	-	-	-	-	1	2	2	2
4	2	2	2	2	2	-	2	-	-	-	-	1	2	2	2
5	2	2	-	-	-	3	-	3	2	-	-	1	2	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20MEE404 **INDUSTRIAL CASTING TECHNOLOGY**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the basic principles of metal casting.
- To know the various types of melting practices.
- To learn about the various casting techniques
- To broaden the understanding of casting design principles.
- To know about casting defects and its remedial measures and automation.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the activities of foundry shop. **(K1)**
CO2 - Describe melting process for various alloys. **(K1)**
CO3 - Identify suitable casting techniques for specific applications. **(K1)**
CO4 - Design of gates and risers in castings. **(K6)**
CO5 - Recognize the casting defects and describe foundry automation. **(K1)**

UNIT I MOLDING PRACTICES (9 Hrs)

Introduction to casting and Foundry industry, Basic principles of casting process- Sequence in foundry operation, Pattern materials, Types – Mold core and its types, core making process.

UNIT II MELTING FURNACES (9 Hrs)

Types of Furnaces used in Foundry – Cupola furnace, Melting practice for cast iron, Aluminium alloy, Copper alloy, and Magnesium alloy – Safety considerations.

UNIT III SPECIAL CASTING TECHNIQUES (9 Hrs)

Investment casting, Shell mould casting, Pressure Die casting – centrifugal casting – Types, CO2 mold casting, Continuous casting, Full mould casting, Evaporative pattern castings.

UNIT IV SOLIDIFICATION OF CASTINGS (9 Hrs)

Concept of solidification, Directional solidification – Gating and Risering design and analysis – Solidification of pure metals – Rate of solidification, Macro and Micro structure – Solidification contraction.

UNIT V CASTING DEFECTS AND AUTOMATION (9 Hrs)

Defects in casting and its remedies – Melting and Quality control of various steels and non-ferrous alloys – Fettling, Cleaning and Inspection of casting – Foundry automation – Mould machine automation of sand plant – moulding and fettling section of foundry.

Text Books

1. Richard W.Heine et al. - Principles of Metal Casting, Tata McGraw Hill Edition, 2013.
2. P.L.Jain, Principles of Foundry Technology, Tata McGraw Hill, 2009.
3. O.P.Khanna, Foundry Technology, DhanpatRai Publications, 2011.

Reference Books

1. B.Wulff, H.F.Taylor, M.C.Fleming, Foundry Engineering, Wiley Eastern, 1999.
2. N.K.Srinivasan, Foundry Technology, Khanna Publications, 2001.
3. T.V. Ramana Rao, Metal Casting: Principles and Practice, New Age International, 2010.
4. Peter Beeley, Foundry Technology, Elsevier, Second Edition, 2001.
5. John Campbell, Complete Casting Handbook: Metal Casting Processes, Metallurgy, Techniques and Design, Elsevier, 1st Edition, 2011.

Web References

1. https://nptel.ac.in/courses/112/107/112107215/
2. https://nptel.ac.in/courses/112/107/112107083/
3. https://nptel.ac.in/courses/112/107/112107219/
4. https://cursa.app/en/course/mechanical-metal-casting-by-nptelhrd/9R19vNE1w2c
5. http://www.infocobuild.com/education/audio-video-courses/mechanical-engineering/principles-of-casting-technology-iit-roorkee.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	1	-	-	-	-	-	-	-	-	1	1	1	-
2	1	-	1	-	-	-	-	-	-	-	-	1	1	1	-
3	1	-	1	-	-	-	-	-	-	-	-	1	1	1	-
4	1	-	1	-	-	-	-	-	-	-	-	1	1	1	-
5	1	-	1	-	-	-	-	-	-	-	-	1	1	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20MEE405 **NON - CONVENTIONAL ENERGY SOURCES**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To introduce the basics of NCES and statistical data on conventional energy resources.
- To study about the concept of solar energy and its types
- To learn the wind energy conversion systems
- To provide knowledge on geothermal energy resources and biomass energy conversion systems
- To impart knowledge about tidal, wave and OTEC energy power generation system

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the basics of NCES. **(K1)**
CO2 - Extract on the solar energy and its conversion systems. **(K2)**
CO3 - Describe the concepts of Wind energy conversion systems. **(K1)**
CO4 - Describe the harnessing of Geothermal, Ocean energies. **(K1)**
CO5 - Compare the tidal, wave and OTEC energy power generation system. **(K2)**

UNIT I STATISTICS ON CONVENTIONAL ENERGY SOURCES (9 Hrs)

Statistics on conventional energy sources and supply in developing countries, Definition Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. Classification of NCES – Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

UNIT II SOLAR ENERGY (9 Hrs)

Solar Energy-Energy available form Sun, Solar radiation data, Solar energy conversion into heat, Flat plate and Concentrating collectors, Mathematical analysis of Flat plate collectors and collector efficiency, Principle of Natural and Forced convection, Solar engines-Stirling, Brayton engines, Photovoltaic, p-n junction, solar cells, PV systems, Stand-alone, Grid connected solar power satellite.

UNIT III WIND ENERGY (9 Hrs)

Wind energy conversion, General formula -Lift and Drag- Basis of wind energy conversion – Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle.

UNIT IV GEOTHERMAL SOURCES (9 Hrs)

Nature of Geothermal sources, Definition and classification of resources, Utilization for electric generation and direct heating, Well Head power generating units, Basic features Atmospheric exhaust and condensing, exhaust types of conventional steam turbines. Pyrolysis of Biomass to produce solid, liquid and gaseous fuels, Biomass gasification, Construction details of gasifier, usage of biogas for chulhas, various types of chulhas for rural energy needs

UNIT V WAVE, TIDAL AND OTEC ENERGY (9 Hrs)

Wave, Tidal and OTEC energy- Difference between tidal and wave power generation, Principles of tidal and wave power generation, OTEC power plants, Operational of small cycle experimental facility, Design of 5 MW OTEC pro-commercial plant, Economics of OTEC, Environmental impacts of OTEC. Status of multiple product OTEC systems.

Text Books

1. Khan , Non-Conventional Energy Resources, McGraw Hill Education India Private Limited; Third edition, 2017
2. S. S. Thipse, Non-Conventional and Renewable Energy Sources, Narossa publisher 2018.
3. N.K.Bansal, Non-Conventional Energy Resources, Vikas Publishing House, 2014

Reference Books

1. R.Ramesh and K.U.Kumar, Renewable Energy Technologies, Narosa Publishing House, New Delhi, 2004.
2. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 5th edition, 2011.
3. MM.Wakil, Power Plant Technology, McGraw Hill Book Co, New Delhi, 2004.
4. Magal, "Solar Power Engineering", Tata McGraw Hill, 2005.
5. Non – Conventional Energy Sources. G.D. Rai, Khanna Publishers, 4th edition, 2009.

Web References

1. https://nptel.ac.in/courses/121/106/121106014/
2. https://nptel.ac.in/courses/108/108/108108078/
3. https://www.coursera.org/courses?query=renewable%20energy
4. https://www.youtube.com/watch?v=GRwJqD4StEU
5. https://www.youtube.com/watch?v=mSIMA6H80mM

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1
2	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1
3	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1
4	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1
5	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

Annexure 3.12

PROFESSIONAL ELECTIVES - I

		L	T	P	C	Hrs
U20MEE405	**NON - CONVENTIONAL ENERGY SOURCES**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To introduce the basics of NCES and statistical data on conventional energy resources.
- To study about the concept of solar energy and its types
- To learn the wind energy conversion systems
- To provide knowledge on geothermal energy resources and biomass energy conversion systems
- To impart knowledge about tidal, wave and OTEC energy power generation system

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the basics of NCES. **(K1)**
CO2 - Extract on the solar energy and its conversion systems. **(K2)**
CO3 - Describe the concepts of Wind energy conversion systems. **(K1)**
CO4 - Describe the harnessing of Geothermal, Ocean energies. **(K1)**
CO5 - Compare the tidal, wave and OTEC energy power generation system. **(K2)**

UNIT I STATISTICS ON CONVENTIONAL ENERGY SOURCES (9 Hrs)

Statistics on conventional energy sources and supply in developing countries, Definition Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. Classification of NCES – Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

UNIT II SOLAR ENERGY (9 Hrs)

Solar Energy-Energy available form Sun, Solar radiation data, Solar energy conversion into heat, Flat plate and Concentrating collectors, Mathematical analysis of Flat plate collectors and collector efficiency, Principle of Natural and Forced convection, Solar engines-Stirling, Brayton engines, Photovoltaic, p-n junction, solar cells, PV systems, Stand-alone, Grid connected solar power satellite.

UNIT III WIND ENERGY (9 Hrs)

Wind energy conversion, General formula -Lift and Drag- Basis of wind energy conversion – Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle.

UNIT IV GEOTHERMAL AND BIOMASS SOURCES (9 Hrs)

Nature of Geothermal sources, Definition and classification of resources, Utilization for electric generation and direct heating, Well Head power generating units, Basic features Atmospheric exhaust and condensing, exhaust types of conventional steam turbines. Pyrolysis of Biomass to produce solid, liquid and gaseous fuels, Biomass gasification, Construction details of gasifier, usage of biogas for chulhas, various types of chulhas for rural energy needs

UNIT V WAVE, TIDAL AND OTEC ENERGY (9 Hrs)

Wave, Tidal and OTEC energy- Difference between tidal and wave power generation, Principles of tidal and wave power generation, OTEC power plants, Operational of small cycle experimental facility, Design of 5 MW OTEC pro-commercial plant, Economics of OTEC, Environmental impacts of OTEC. Status of multiple product OTEC systems.

Text Books

1. Khan , Non-Conventional Energy Resources, McGraw Hill Education India Private Limited; Third edition, 2017
2. S. S. Thipse, Non-Conventional and Renewable Energy Sources, Narossa publisher 2018.
3. N.K.Bansal, Non-Conventional Energy Resources, Vikas Publishing House, 2014

Reference Books

1. R.Ramesh and K.U.Kumar, Renewable Energy Technologies, Narosa Publishing House, New Delhi, 2004.
2. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 5th edition, 2011.
3. MM.Wakil, Power Plant Technology, McGraw Hill Book Co, New Delhi, 2004.
4. Magal, "Solar Power Engineering", Tata McGraw Hill, 2005.
5. Non – Conventional Energy Sources. G.D. Rai, Khanna Publishers, 4th edition, 2009.

Web References

1. https://nptel.ac.in/courses/121/106/121106014/
2. https://nptel.ac.in/courses/108/108/108108078/
3. https://www.coursera.org/courses?query=renewable%20energy
4. https://www.youtube.com/watch?v=GRwJqD4StEU
5. https://www.youtube.com/watch?v=mSIMA6H80mM

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1
2	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1
3	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1
4	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1
5	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEE55	**IOT AND SMART MANUFACTURING**	L	T	P	C	Hrs.
		3	0	0	3	45

Course Objectives

- To present a problem oriented in depth knowledge of IOT and Smart Manufacturing.
- To address the underlying concepts and methods behind IOT and Smart Manufacturing.
- To learn about the smart manufacturing distinguish its signification in comparison to conventional manufacturing.
- To Study about tools for Smart Manufacturing and its application.
- To study about Smart and Empowered working.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Identify different areas of IOT and Smart Manufacturing. **(K1)**
CO2 - Acquire a broad view about automatic storage management and its governance. **(K2)**
CO3 - Get a knowledge about smart manufacturing. **(K1)**
CO4 - Attain knowledge about smart design and find applications of all the areas in daily life. **(K2,K6)**
CO5 - Become familiarize with elimination of error with smart tools in operations. **(K5)**

UNIT I INTERNET OF THINGS (9 Hrs)

The Internet of Things: An overview; Design Principles for Connected Devices; Internet Principles. Thinking about Prototyping – Costs versus ease of prototyping, prototyping and Production, open source versus Closed Source. Proto typing Embedded devices – Electronics, Embedded Computing Basics, Arduino/ Raspberry Pi/ Beagle Bone Black/ etc., Electric Imp and other notable platforms Prototyping of Physical Design. Prototyping online Components – Getting Started with an API, Writing a New API, Real Time Reactions, Other Protocols. Techniques for Writing Embedded Code – Memory Management, Performance and Battery Life, Libraries and debugging.

UNIT II AUTOMATIC STORAGE MANAGEMENT AND SECURITY (9 Hrs)

Automatic Storage Management in a Cloud World – Introduction to Cloud, Relational Databases in the Cloud, Automatic Storage Management in the Cloud. Smart Connected System Design Case Study Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smarty Approach. Data Aggregation for the IoT in Smart Cities, Security

UNIT III INTRODUCTION TO SMART MANUFACTURING (9 Hrs)

Introduction to "smart manufacturing"- conventional/legacy manufacturing-Smart Manufacturing Processes-Three Dimensions: (1) Demand Driven and Integrated Supply Chains;(2) Dynamically Optimized Manufacturing Enterprises (plant + enterprise operations);(3) Real Time, Sustainable Resource Management (intelligent energy demand management, production energy optimization and reduction of GHG)

UNIT IV SMART DESIGN/FABRICATION (9 Hrs)

Smart Design/Fabrication - Digital Tools, Product Representation and Exchange Technologies and Standards, Agile (Additive) Manufacturing Systems and Standards. Mass Customization, Smart Machine Tools, Robotics and Automation (perception, manipulation, mobility, autonomy), Smart Perception – Sensor networks and Devices. Smart Applications: Online Predictive Modelling, Monitoring and Intelligent Control of Machining/Manufacturing and Logistics/Supply Chain Processes; Smart Energy Management of manufacturing processes and facilities

UNIT V SMART AND EMPOWERED WORKERS (9 Hrs)

Eliminating Errors and Omissions, Deskilling Operations, Improving Speed/Agility, Improving Information Capture/Traceability, Improving Intelligent Decision Making under uncertainty Assisted/Augmented Production, Assisted/Augmented Assembly, Assisted/Augmented Quality, Assisted/Augmented Maintenance, Assisted/Augmented Warehouse Operations and Assisted Training

Text Books

1. Zaigham Mahmood - The Internet of Things in the Industrial Sector – Springer – 1st edition – 2019
2. Loveleen Gaur Internet of Things: Approach and Applicability in Manufacturing- Chapman and Hall/CRC -1st Edition - 2019
3. A.McEwen and H. Cassimally, Designing the Internet of Things, 1stedition, Wiley, 2014.

Reference Books

1. N. Vengurlekar and P. Bagal, Database Cloud Storage: The Essential Guide to Oracle Automatic Storage Management, 1st edition, McGraw-Hill Education, 2013.
2. **B.K. Tripathy** - Internet of Things (IoT): Technologies, Applications, Challenges and Solutions - CRC Press 1st Edition 2018.
3. S. Jeschke, C. Brecher, H. Song, and D. B. Rawat, Industrial Internet of Things: Cyber manufacturing Systems, Springer, 1st edition, 2017.
4. A. Bahga and V. Madisetti, Internet of Things, A hands-on approach, Create Space Independent Publishing Platform, 1st edition, 2014.
5. M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann, 2013.

Web References

1. https://nptel.ac.in/courses/106/105/106105195/
2. https://www.digimat.in/nptel/courses/video/106105195/L10.html
3. https://www.youtube.com/watch?v=EV1Ygw6_rCs
4. https://www.sciencedirect.com/journal/internet-of-things
5. https://www.digimat.in/nptel/courses/video/106105195/L01.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-
4	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
5	3	3	2	3	-	-	-	-	-	-	-	-	1	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

Annexure 3.1**6**
PROFESSIONAL ELECTIVE - III

		L	T	P	C	Hrs
U19MEE65	**ENERGY AND CLIMATE CHANGE**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To impart knowledge on the global warming, the impact of climate change on society
- To recommend adaptation and mitigation measures
- To understand about the climate change effects on environment
- To provide knowledge on mitigating climate change
- To differentiate alternate and renewable fuels

Course Outcomes

After completion of the course, the students will be able to

CO1 - An insight into carbon cycle, physical basis of the natural greenhouse effect, including the meaning of the term radioactive forcing, climate change, global warming and measures **(K3)**

CO2 - Adapt and mitigate the impacts of climate change. **(K2)**

CO3 - Understand the growing scientific consensus established through the IPCC as well as the complexities and uncertainties **(K3)**

CO4 - Plan climate change mitigation and adaptation projects **(K2)**

CO5 - Use of alternate fuels and renewable energy **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Atmosphere – weather and Climate – climate parameters – Temperature, Rainfall, Humidity, Wind – Global ocean circulation – El Nino and its effect – Carbon cycle

UNIT II ELEMENTS RELATED TO CLIMATE (9 Hrs)

Greenhouse gases – Total carbon dioxide emissions by energy sector – industrial, commercial, transportation, residential – Impacts – air quality, hydrology, green space – Causes of global and regional climate change – Changes in patterns of temperature, precipitation and sea level rise – Greenhouse effect

UNIT III IMPACTS OF CLIMATE CHANGE (9 Hrs)

Effects of Climate Changes on living things – health effects, malnutrition, human migration, socioeconomic impacts- tourism, industry and business, vulnerability assessment- infrastructure, population and sector – Agriculture, forestry, human health, coastal areas

UNIT IV MITIGATING CLIMATE CHANGE (9 Hrs)

IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation -Identifying adaption options – designing and implementing adaption measures – surface albedo environment reflective roofing and reflective paving enhancement of evapotranspiration – tree planting programme – green roofing strategies – energy conservation in buildings – energy efficiencies – carbon sequestration.

UNIT V UP-SCALING RENEWABLE ENERGY: POLICY INCENTIVES (9 Hrs)

Energy source - Biofuels – Energy policies for a cool future – Energy Audit - Energy and climate governance, Global Energy - Energy - Geopolitics - Energy Security - Energy Production - Energy Consumption - Energy Markets - Energy Policy.

.

Text Books

1. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2014.
2. Velma. I. Grover “Global Warming and Climate” Change. Vol. I and II. Science Publishers, 2005.
3. Twidell and wier” Renewable energy resources”, CRC press (Taylor and Francis), 2015.

Reference Books

1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK, 2007.
2. Thomas E, Lovejoy and Lee Hannah “Climate Change and Biodiversity”, TERI Publishers, 2018.
3. Jan C. van Dam, Impacts of “Climate Change and Climate Variability on Hydrological Regimes”, Cambridge University Press, 2011.
4. Tiwari and Ghosal” Renewable energy resources” Narosa publications, 2005.
5. Ramesh and Kumar” Renewable Energy Technologies “Narosa publications, 2015.

Web References

1. https://nptel.ac.in/courses/119/106/119106008/
2. https://swayam.gov.in/nd2_arp19_ap55/preview
3. https://nptel.ac.in/courses/103/107/103107157/
4. https://olc.worldbank.org/content/climate-change-online-learning
5. https://nptel.ac.in/courses/119/106/119106015/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	-	2	1	1	-	-	-	2	1	2	2
2	3	1	1	2	-	1	2	1	-	-	-	2	2	1	2
3	3	2	2	1	-	2	1	1	-	-	-	1	1	1	2
4	3	2	1	2	-	2	2	1	-	-	-	1	1	2	1
5	3	2	2	1	-	1	2	1	-	-	-	2	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

Annexure 5

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society.

Mission

M1: Quality Education:

To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation:

To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship:

To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values:

To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

DEPARTMENT VISION AND MISSION

Vision

The Mechanical Engineering department strives to be recognized as an excellent academic and research center for creating outstanding Engineers, Entrepreneurs and Leaders

Mission

M1: Professional Skills:

To provide quality education to enhance students inter-personal and intra-personal skills

M2: State-of-art facilities:

To render excellent infrastructure facilities and laboratories to excel as skilled professionals

M3: Research Exposure:

To Strengthen Research and Development within the department through industrial associations

M4: Employability:

To put enthusiastic exertions to enhance employability and entrepreneurship skills of students

M5: Human Values:

To empower students with professional ethics and human values to serve the society

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge:

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

PO2: Problem analysis:

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

PO3: Design/development of solutions:

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

PO4: Conduct investigations of complex problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage:**

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

PO6: The engineer and society:

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

PO7: Environment and sustainability:

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

PO8: Ethics:

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

PO9: Individual and team work:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication:

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

PO11: Project management and finance:

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

PO12: Life-long learning:

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Technical knowledge

To foster our young graduates with cogent technical knowledge so as to make them employable

PEO2: Real-Time Applications

To apply the acquired knowledge in the field of Mathematics, Science and Engineering in developing real-time projects

PEO 3: Design Ability

To design a system, component or process to meet the desired needs within realistic constraints such as manufacturing, economy, environmental sustainability, social, health and safety

PEO 4: Ethics

To prepare the students to become entrepreneurs with professional attitude in the broader ethical perspective

PEO 5: Life - Long Learning

To craft curiosity among students for life-long learning through self-study

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Solving real time problems

To develop capability to identify, analyze and solve engineering problems in concern to mechanical engineering along with associated engineering streams.

PSO 2: Pursue Professional career

To bestow quality learning environment to pursue professional career in mechanical engineering with integrated knowledge

PSO 3: Concentrating on skill development

To enflame the student's technical capabilities in engineering design process, intra and inter personnel, linguistic and higher level professional skills required in engineering.

Annexure 8

Diploma lateral entry - more courses to be added as per TNEA /CENTAC / PTU revised guidelines

1. Mechanical and Rural Engineering
2. Mechanical Engineering (Sandwich)
3. Tool Design Mechanical Engineering (Tool Die)
4. Agricultural engineering and Farm Equipment Technology
5. Electronics (Robotics) (Sandwich)
6. Mechanical Design and Drafting
7. Foundry Technology (Sandwich)
8. Mechanical Engineering (Refrigeration and A/C)
9. Production Engineering (Sandwich)
10. Metallurgy Mechatronics Engineering
11. Machine Tool Maintenance and Repairs Tool and Die Making
12. Machine Tool Maintenance and Repairs (Sandwich) Tool and Die Making (Sandwich)
13. Electronics (Robotics)
14. Mechatronics Engineering (Sandwich)

Annexure **10**

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)
(Accredited by NBA-AICTE, New Delhi, ISO 9001:2000 Certified Institution & Accredited by NAAC with "A" Grade)

Madagadipet, Puducherry - 605 107

Panel of Chief and Examiners for Valuation of End Semester Examinations Jan/ Feb 2021

Department of Mechanical Engineering

SMVEC/ Dept/ Exam-Cell/Valuation/20-21/003 Year/Sem:III /V & II/III

Sl.No	Name of the Examiner	Specialization	Designation, Department and Institution in which currently working	Contact number and mail id
1	Dr.G.B.M.Mohanraj **(CHIEF EXAMINER)**	Manufacturing Engineering	Professor Department of Mechanical Engineering Sri Manakula Vinayagar Engineering college Madagadipet-605107	9600989508 gbmraj@gmail.com
External Examiners				
2	Dr.S.Gopalakannan	Manufacturing Engineering	Professor Department of Mechanical Engineering Adhiparasakthi Engineering college Melmaruvathure-632 506	9944949026 gopalakannan75@gmail.com
3	Dr.V.Gnanamoorthy	Thermal Engineering	Assistant Professor Department of Mechanical Engineering University college of Engineering Villupuram-605103	9942005782 cvgnana@gmail.com
4	Dr. A.Sathiamourtty	Energy Technology	Associate Professor Dept. of Mechanical Engg. Pondicherry Engineering College	8300460801 asm@pec.edu

5	Dr.Nadanakumar	Thermal Engineering **(HMT & ATD)**	Assistant Professor(S.G) School of Mechanical Science Hindustan Institute of Science Chennai	9443693363 vin.nadanakumar@gmail.com
6	Dr.U.Mohammed.Iqbal	Manufacturing Engineering **(MQC & MM)**	Associate Professor Department of Mechanical Engineering S.R.M Institute of Science and Technology Kattankulathur-603203.	9600429006 mohammeu@srmist.edu.in
7	Dr.S.Sivakumar	**(SOM & FMHM)**	Associate Professor Department of Mechanical Engineering Hindustan Institute of technology Padur,Chennai	9894523361 Sivakumar71078@gmail.com
8	Dr.C.Beenat	Thermal Engineering **(HMT & ATD)**		9942658638
9	Dr.R.Srinivasan	Thermal Engineering **(HMT & ATD)**	Professor & Head Salem college of Engineering and Technology Salem.	9443708013 sri_eniya@yahoo.com
10	Dr.V.K.Krishnan	Thermal Engineering **(HMT & ATD)**	Associate Professor Department of Mechanical Engineering Vinayaka Mission's kirupananda Variyar Engineering College,Salem	9976881749 vkkrishnaphd@gmail.com
11	Dr.S.Arunkumar **(Sunday)**	Manufacturing Engineering **(ICT)**	Associate Professor Department of Mechanical Engineering Vinayaka Mission's kirupananda Variyar Engineering College,Salem	9952722454 arun_da78@yahoo.co.in
12	Dr.C..Senthilkumar **(Sunday)**	Manufacturing Engineering	Assistant Professor Department of Mechanical Engineering University college of Engineering Panruti-607106	9894856176 csmfgau@gmail.com

Internal Examiners				
13	Dr.G.G.Sozhamannan	Manufacturing Engineering **(ICT & MM)**	Professor Department of Mechanical Engineering Sri Manakula Vinayagar Engineering college Madagadipet-605107	9677858206 cholaking3007@gmail.com
14	Dr.T.Coumaressin	Energy Engineering **(HMT, ATD & FMM)**	Associate Professor Department of Mechanical Engineering Sri Manakula Vinayagar Engineering college Madagadipet-605107	9994138268 coumaressinmech09@gmail.com
15	Dr.K.Hemalatha	Engineering Design **(DOM)**	Associate Professor Department of Mechanical Engineering Sri Manakula Vinayagar Engineering college Madagadipet-605107	9443536684 hemalatharohit@gmail.com
16	Dr.A.Thiyagarajan	Manufacturing Engineering **(EM & FMM)**	Associate Professor Department of Mechanical Engineering Sri Manakula Vinayagar Engineering college Madagadipet-605107	6379367126 thiagusmvec@gmail.com

SMVEC/Mech/QP Setter/B.Tech(First Year)/ODD 2020-21/004

DEPARTMENT OF MECHANICAL ENGINEERING

QUESTION PAPER SETTER DETAILS-ODD SEMESTER 2021-2022

Sl. No	Sem	Name of the Subject	Question Paper Setter Details		
			Setter 1	Setter 2	Setter 3
1	1	U20BST101/ Engineering Mathematics I	**Dr. S. Tamilselvan** Professor Department of Mathematics, Annamalai University , Chidambaram -608002 Contact No: 9443073937 E-Mail: stamilselvan@hotmail.com	**Dr. S. Vijayabalaji** Assistant Professor Department of Mathematics University College of Engineering Panruti- Contact No: 9443682630 E-Mail:balaji1977harshini@gmail.com	**Dr. Pazhani Balamurugan** Associate Professor Department of Mathematics Annamalai University, Chidambaram -608002 Contact No: 9488026946 E-Mail: spbm1966@gmail.com
2	1	U20BST106/ Physics for Mechanical Engineering	**Dr.E.Edward Anand** Professor Department of Physics EGS Pillay Engineering College, Nagapattinam- 611002 Contact No:9843445487 Email:alphsedward@gmail.com	**Dr. R. Vasantha Jayakantha Raja** Assistant Professor Sastra University, Thanjavur - 612001 Contact Number 9442034516 E-Mail: vasanth.raja@gmail.com	**Dr. S.Dhinakaran** Assistant Professor Department of Physics University College of Engineering, Thirukulai. 610 204. Contact No: 9994307593 E-Mail:sugadinagokul@gmail.com
3	1	U20BST107/ Material Science and Engineering	**Dr. R. Elansezhian** Professor Department of Mechanical Engineering PEC Puducherry -605104 Contact No: 9952884403 E-Mail: elansezhianr@pec.edu	**Dr. R. Anbazhagan** Associate Professor Department of Mechanical Engineering Vel Tech High Tech Dr. Rangarajan Dr. Sakunthala Engineering College, Avadi, Chennai - 600062 Contact No: 9994309413 E-Mail: luckyanbu@gmail.com	**Dr. L. Poovazhagan** Associate Professor Department of Mechanical Engineering,SSN, Tamil Nadu 600020 Contact No: 9962521304 E-Mail: poovazhaganl@ssn.edu.in

4	I	U20EST117/ Basic Electrical and Electronics Engineering	**Dr.S.Durai** Associate Professor, Department of Electrical and Electronics Engineering, Annamalai University Chidambaram Contact No: 8667264066 E-Mail: abcddurai@gmail.com	**Dr .V. Kamatchi Kannan** Associate Professor, Department of Electrical and Electronics Engineering, Bannari Amman Institute of Technology, Sathyamangalam -638401. Contact No : 9944374946 E-Mail : kannan.ped@gmail.com.	**Dr. R .Gunabalan** Associate Professor, School of Electrical Engineering, VIT, Vandalur - Kelambakkam Road, Chennai-600 127 Contact No: 9894919269 E-Mail : gunabalan.r@vit.ac.in
5	1	U20EST119/ Engineering Mechanics	**Dr. S. Mohamed Ali** Professor Department of Mechanical Engineering PEC Puducherry -605104 Contact No: 9443099866 E-Mail: smdali@pec.edu	**Dr. N. Pannirselvam** Associate Professor Department of Civil Engineering, Kattankulathur Campus, SRM Institute of Science and Technology, Tamil Nadu 603203 Contact No: 9994309413 E-Mail: pannirsn@srmist.edu.in	**Dr.G. Suganya Priyadharshini** Assistant Professor Department of Mechanical Engineering CIT Coimbatore- 641 014 Contact No: 9843980133 E-Mail: suganyapriyadharshini.g@cit.edu.in

Department of Mechanical Engineering

Minutes of Board of Studies

The Second Board of Studies meeting for M.Tech and Ph.D Programmes, Department of Mechanical Engineering was held on 10th April 2021 at 10:30 A.M in the R&D Lab, Department of Mechanical Engineering, Sri Manakula Vinayagar Engineering College with the Head of the Department in the Chair.

The following members were present for the BoS meeting:

Sl. No	Name of the Member with Designation and official Address	Responsibility in the BoS
1	Dr. K.Velmurugan Professor and Head Department of MECH, SMVEC	Chairman
External Members		
2	Dr. N. Alagumurthi, Ph.D, Professor & Head Department of Mechanical Engineering, Pondicherry Engineering College, Puducherry-605014. Email id: alagumurthi@pec.edu Mobile No.: 9486143090	University Nominee
3	Dr. M. Leenus Jesu Martin, Ph.D, Director for campus SRM Institute of Science and Technology, Tamil Nadu – 603203 Email id: hod.auto@ktr.srmuniv.ac.in Mobile No.: 9940036021	Member
4	Dr. A.T. Ravichandran, Ph.D, Dean School of Mechanical and Construction Engineering Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology, Avadi, Chennai – 600062 Email id: hodmech@veltech.edu.in Mobile No.: 9942940600	Member
Internal Members		
5	Dr.G.G.Sozhamannan, Professor, **Specialization:** ***Manufacturing Engineering***	Member
6	Dr.T.Coumaressin, Associate Professor, **Specialization:** ***Thermal Engineering***	Member

7	Dr.K.Hemalatha, Associate Professor, **Specialization:** ***Engineering Design***	Member
8	Dr.A.Thiagarajan, Associate Professor, **Specialization:** ***Product Design & Manufacturing***	Member
9	Prof.N.Vijayan, Assistant Professor, **Specialization:** ***Mathematics***	Member
10	Prof.K.Oudayakumar Associate Professor, **Specialization:** ***Physics***	Member
11	Dr.K.Karthikeyan Associate Professor, **Specialization:** ***Chemistry***	Member
12	Dr.D.Jaichithra, Professor, **Specialization:** ***English***	Member
Co-opted Members		
13	Dr. Anand Gurupatham Deputy General Manager, CAE-Department Head at Renault Nissan, Technology & Business Center, Chennai, Tamil Nadu, India	Industrial Member
Alumni		
14	Mr.P.Madavan, Research Scholar MIT, Anna university, Chennai.	Alumni Member

Agenda of the Meeting

1. Consideration of confirmation of minutes of the previous meeting held on 17.07.2020 and ratify the note on action taken on the decisions PG programmes of the previous meeting
2. To consider and ratify the Common Course introduced in PG programmes from the Academic Year 2020-21
3. Consideration and approve the students admitted in the Academic Year 2020-21.
4. Approval for the panel of examiners
5. Consideration and approve of Ph. D Course Work in Mechanical Engineering.
6. Consideration of Name change of M.Tech Program from Manufacturing Engineering to M.Tech - Automation and Robotics Production
7. Any other item with the permission of chair

PG and Ph.D Minutes of the Meeting

Dr. K.Velmurugan, Chairman, BoS opened the meeting by welcoming and introducing the external members, to the internal and co-opted members and thanked them for accepting to become the member of the Board of Studies and the meeting thereafter deliberated on agenda items that had been approved by the Chairman.

Item:1

Consideration of confirmation of minutes of the previous meeting held on 17.07.2020

- The chairman BoS Confirmed the minutes of 1st Board of Studies meeting with no further modification.
- To consider and ratify the note on action taken on the decisions PG programmes of the previous meeting

Suggestion given by the Member	Action Taken
Suggested to include Research Methodology and IPR paper in Semester -I.	Course was introduced in Semester-I
Suggested to include AICTE recommended Audit Course in Semester I&II	Audit course was introduced in Semester-I &II

Item:2

To consider and ratify the Common Course introduced in PG programmes from the Academic Year 2020-21 :

The following common courses are introduced in semester I and II in all M.Tech programmes as per guidelines of AICTE model curriculum.

Semester	Course Code	Course Title	Objective of the Course
1	P20CCT101	Research Methodology and IPR	• To impart knowledge and skills required for research and IPR • Problem formulation, analysis and solutions • Technical paper writing / presentation without violating professional ethics • Patent drafting and filing patents
1	P20CCP101	Technical Report Writing and Seminar	• Selection of topic based on interest • Formulate the Objective • To develop their scientific and technical reading and writing skills by which they need to understand and construct research articles. • To obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. • Preparation of report

Item:2

2	P20CCP202	Seminar on ICT a hands on approach	• To develop their technical reading and presentation skills that they need to understand and present using ICT Tools. • To obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and practice to present.

Audit Courses

The All India Council for Technical Education (AICTE) introduced Audit courses in M.Tech programmes covering subjects of developing desired attitude among the learners is on the line of initiatives such as Unnat Bharat Abhiyan, Yoga, Value education, Disaster management, Sanskrit, Pedagogy, Constitution of India, Personality development through Indian culture etc. The students are asked to complete minimum two audit courses in duration of the program.

Sl. No	Course Code	Course Title
1	**P20ACTX01**	**English for Research Paper Writing**
2	P20ACTX02	Disaster Management
3	P20ACTX03	Sanskrit for Technical Knowledge
4	P20ACTX04	Value Education
5	P20ACTX05	Constitution of India
6	P20ACTX06	Pedagogy Studies
7	P20ACTX07	Stress Management by Yoga
8	P20ACTX08	Personality Development Through Life Enlightenment Skills
9	P20ACTX09	Unnat Bharat Abhiyan

The common courses mentioned above had been introduced in Semester I & II and audit courses from the academic year 2020-21 under Regulations 2020. The BoS members discussed and ratified the courses which was introduced in M.Tech programmes.

Considered and ratified changes made in M.Tech curriculum and syllabi

Item:3

Consideration and approve the students admitted in the Academic Year 2020-21:

The details of the students admitted in M. Tech – Manufacturing Engineering in the academic year 2020-21

Name of the Programs	Number of students admitted
M.Tech – Manufacturing Engineering	8
Total Number of Students	**8**

Overall admission for the academic year 2020-21 is 8.

Item:4

Approval for the panel of examiners:

The list of question paper setters for End semester Examination was presented and recommended by BoS Members to academic council. **Annexure I**

Item:5	Consideration and approve of Ph. D Course Work in Mechanical Engineering. The members reviewed the Ph.D regulations and suggested to include the Course work in R20. • As per the recommendations of UGC (**Annexure -II**)**, Research & Publications Ethics and Research Methodology papers** (Theory -2 credit) was made compulsory for Research Scholars admitted in 2020-21. The course work details are also included in Ph. D Regulations (**Annexure-III**).
Item:6	Consideration and approve of Name change of M. Tech Programme from Manufacturing Engineering to M. Tech - Automation and Robotics Production: • Keeping in view of Industry 4.0 requirements and expand of admission, it is proposed to change M. Tech Manufacturing Engineering to M. Tech - Automation and Robotics Production.
Item:7	**Other points Discussed** • Course coordinator committee meeting along with students representatives to be conducted at the end of the semester, to discuss about the discrepancies faced like depth of syllabus, hours allotted for completing the syllabus and students feedbacks related to the curriculum and the subjects

The meeting was concluded at 01:30PM with vote of thanks by Dr.K.Velmurugan, Head of Department, Mechanical Engineering

Sl. No	Name of the Member with Designation and official Address	Responsibility in the BoS	Signature
1	Dr. K.Velmurugan Professor and Head Department of MECH, SMVEC	Chairman	
External Members			
2	Dr. N. Alagumurthi, Ph.D, Professor & Head Department of Mechanical Engineering, Pondicherry Engineering College, Puducherry-605014. Email id: alagumurthi@pec.edu Mobile No.: 9486143090	University Nominee	
3	Dr. M. Leenus Jesu Martin, Ph.D, Director for campus SRM Institute of Science and Technology, Tamil Nadu – 603203 Email id: hod.auto@ktr.srmuniv.ac.in Mobile No.: 9940036021	Member	
4	Dr. A.T. Ravichandran, Ph.D, Dean School of Mechanical and Construction Engineering Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology, Avadi, Chennai – 600062 Email id: hodmech@veltech.edu.in Mobile No.: 9942940600	Member	
Internal Members			
5	Dr.G.G.Sozhamannan, Professor, **Specialization:** ***Manufacturing Engineering***	Member	
6	Dr.T.Coumaressin, Associate Professor, **Specialization:** ***Thermal Engineering***	Member	
7	Dr.K.Hemalatha, Associate Professor, **Specialization:** ***Engineering Design***	Member	
8	Dr.A.Thiagarajan, Associate Professor, **Specialization:** ***Product Design & Manufacturing***	Member	

9	Prof.N.Vijayan, Assistant Professor, **Specialization:** ***Mathematics***	Member	
10	Prof.K.Oudayakumar Associate Professor, **Specialization:** ***Physics***	Member	
11	Dr.K.Karthikeyan Associate Professor, **Specialization:** ***Chemistry***	Member	
12	Dr.D.Jaichithra, Professor, **Specialization:** ***English***	Member	
Co-opted Members			
13	Dr. Anand Gurupatham Deputy General Manager, CAE-Department Head at Renault Nissan, Technology & Business Center, Chennai, Tamil Nadu, India	Industrial Member	
Alumni			
14	Mr.P.Madavan, Research Scholar MIT, Anna university, Chennai.	Alumni Member	

Annexure -I

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)
(Accredited by NBA-AICTE, New Delhi, ISO 9001:2000 Certified Institution & Accredited by NAAC with "A" Grade)
(An Autonomous Institution)
(As per UGC Regulations 2018)
Madagadipet, Puducherry - 605 107

DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech Manufacturing Engineering

QUESTION PAPER SETTER DETAILS-ODD SEMESTER 2021-2022

Sl. No	Sem	Name of the Subject	Question Paper Setter Details		
			Setter 1	Setter 2	Setter 3
1	1	P20BST105/ Engineering Probability and Statistics	**Dr. S. Tamilselvan** Professor Department of Mathematics, Annamalai University, Chidambaram -608002 Contact No: 9443073937 E-Mail: stamilselvan@hotmail.com	**Dr. S. Vijayabalaji** Assistant Professor Department of Mathematics University College of Engineering Panruti- Contact No: 9443682630 E-Mail:balaji1977harshini@gmail.com	**Dr. Pazhani Balamurugan** Associate Professor Department of Mathematics Annamalai University, Chidambaram -608002 Contact No: 9488026946 E-Mail: spbm1966@gmail.com
2	1	P20MET101/ Mechanical Behavior of Materials	**Dr. K. Pajaniradja** Professor Department of Mechanical Engineering PEC Puducherry -605104 Contact No: 9894045673 E-Mail: palaniradja72@pec.edu	**Dr. B. Karthikeyan** Professor Department of Mechanical Engineering Annamalai university Chidambaram-608002 Contact No: 9443665677 E-Mail: profbkau@gmail.com	**Dr. A. K. Lakshminarayanan** Associate Professor Department of Mechanical Engineering SSN Tamil Nadu 600020 Contact No: 9940196356 E-Mail: lakshminarayananak@ssn.edu.in
3	1	P20MET102/ Automation in Manufacturing	**Dr. R. Elansezhian** Associate Professor Department of Mechanical Engineering PEC Puducherry -605104 Contact No: 9952884403 E-Mail: elansezhianr@pec.edu	**Dr.A.Senthil kumar** Assistant Professor Department of Mechanical Engineering University College of Engineering Panruti- 607 106. Contact No: 99948 25959 E-Mail: ask@tau.edu.in	**Dr. Rajesh Ranganathan** Professor Department of Mechanical Engineering CIT- Coimbatore- 641 014 Contact No: 97508 54530 E-Mail: rajesh.ranganathan@cit.edu.in
4	1	P20MET103/ Tool Design Engineering	**Dr. S. Mohamed Ali** Professor Department of Mechanical Engineering PEC Puducherry -605104 Contact No: 9443099866 E-Mail: smdali@pec.edu	**Dr. R. Kalaivanan** Professor Department of Mechanical Engineering Annamalai university Chidambaram-608002 Contact No: 9894857644 E-Mail: rkv1966@yahoo.co.in	**Dr. V. C. Sathish Gandhi** Professor Department of Mechanical Engineering University College of Engineering Nagercoil, Nagercoil - 629004 Contact No: 9894500097 E-Mail: vcsgandhi@gmail.com

5	1	P20CCT101/ Research Methodology And IPR	**Dr.A.V. Raviprakash** Professor Department of Mechanical Engineering PEC Puducherry -605104 Contact No: 9487061455 E-Mail: avrp@pec.edu	**Dr. N. M. Sivaram** Assistant Professor Department of Mechanical Engineering NIT Puducherry, *Karaikal* – 609605 Contact No: 04368 265 230 E-Mail: sivaram.nm@nitpy.a	**Dr.K.Mathiyazhagan** **Associate Professor** **Head of Research Centre** Thiagarajar School of Management, Madurai, Tamil Nadu-625005 Contact No: 9698239312 E-Mail: madii1984@yahoo.com
6	1	P20MEE105/ Cellular Manufacturing	**Dr. L. Poovazhagan** Associate Professor Department of Mechanical Engineering SSN, Tamil Nadu 600020 Contact No: 9962521304 E-Mail: poovazhaganl@ssn.edu.in	**Dr.C.Senthilkumar** Assistant Professor Department of Mechanical Engineering University College of Engineering Panruti- 607 106. Contact No: 9894856176 E-Mail: csmfg_au@yahoo.com	**Dr. M V A Raju Bahubalendruni** Assistant Professor Department of Mechanical Engineering NIT Puducherry, *Karaikal* – 609605 Contact No:- 04368 265 230 E-Mail: mvaraju.b@nitpy.ac.in

Annexure-II

प्रो. रजनीश जैन
सचिव
Prof. Rajnish Jain
Secretary

विश्वविद्यालय अनुदान आयोग
University Grants Commission
(मानव संसाधन विकास मंत्रालय, भारत सरकार)
(Ministry of Human Resource Development, Govt. of India)
बहादुरशाह जफ़र मार्ग, नई दिल्ली-110002
Bahadur Shah Zafar Marg, New Delhi-110002
Ph :. 011-23236288/23239337
Fax : 011-2323 8858
E-mail : secy.ugc@nic.in

D.O.No.F.1-1/2018(Journal/CARE)

December, 2019

Respected Sir/Madam,

University Grants Commission in its 543rd meeting held on 9th August, 2019 approved two Credit Courses for awareness about publication ethics and publication misconducts entitled **"Research and Publication Ethics (RPE)"** to be made compulsory for all Ph.D. students for pre-registration course work (**attached as Annexure**).

In view of the above, you are requested to ensure that the above two Credit courses may be made compulsory for all Ph.D. students for pre-registration course work undertaken in your University from the forthcoming academic session.

With regards,

Yours sincerely,

(Rajnish Jain)

TO THE VICE-CHANCELLORS OF ALL UNIVERSITIES

ANNEXURE

Course Title:

- **Research and Publication Ethics (RPE)**-Course for awareness about the publication ethics and publication misconducts.

Course Level:

- 2 Credit course (30 hrs.)

Eligibility:

- M.Phil., Ph.D. students and interested faculty members (It will be made available to post graduate students at later date)

Fees:

- As per University Rules

Faculty:

- Interdisciplinary Studies

Qualifications of faculty members of the course:

- Ph.D. in relevant subject areas having more than 10 years' of teaching experience

About the course

Course Code: CPE- RPE

Overview

- This course has total 6 units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, research metrics (citations, h-index, Impact Factor, etc.) and plagiarism tools will be introduced in this course.

Pedagogy:

- Class room teaching, guest lectures, group discussions, and practical sessions.

Evaluation

- Continuous assessment will be done through tutorials, assignments, quizzes, and group discussions. Weightage will be given for active participation. Final written examination will be conducted at the end of the course.

Course structure

- The course comprises of six modules listed in table below. Each module has 4-5 units.

Modules	Unit title	Teaching hours
Theory		
RPE 01	Philosophy and Ethics	4
RPE 02	Scientific Conduct	4
RPE 03	Publication Ethics	7
Practice		
RPE 04	Open Access Publishing	4
RPE 05	Publication Misconduct	4
RPE 06	Databases and Research Metrics	7
	Total	**30**

Syllabus in detail

THEORY

- **RPE 01: PHILOSOPHY AND ETHICS (4 hrs.)**

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

- **RPE 02: SCIENTIFICCONDUCT (4hrs.)**

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

- **RPE 03: PUBLICATION ETHICS (7 hrs.)**

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

PRACTICE

- **RPE 04: OPEN ACCESS PUBLISHING(4 hrs.)**

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

- **RPE 05: PUBLICATION MISCONDUCT (4hrs.)**

A. Group Discussions (2 hrs.)

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

B. Software tools (2 hrs.)

Use of plagiarism software like Turnitin, Urkund and other open source software tools

- **RPE 06: DATABASES AND RESEARCH METRICS (7hrs.)**

A. Databases (4 hrs.)

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics (3 hrs.)

1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
2. Metrics: h-index, g index, i10 index, altmetrics

References

Bird, A. (2006). *Philosophy of Science*. Routledge.

MacIntyre, Alasdair (1967) *A Short History of Ethics*. London.

P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865

National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). *On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition*. National Academies Press.

Resnik, D. B. (2011). What is ethics in research & why is it important. *National Institute of Environmental Health Sciences*, 1–10. Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm

Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179–179. https://doi.org/10.1038/489179a

Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance(2019), ISBN:978-81-939482-1-7. http://www.insaindia.res.in/pdf/Ethics_Book.pdf

Annexure-III

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE
(An Autonomous Institution)
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)
(Accredited by NBA-AICTE, New Delhi, ISO 9001:2000 Certified Institution & Accredited by NAAC with "A" Grade)
Madagadipet, Puducherry - 605 107

Research and Development Cell

Ph.D Course Work guidelines: Mandatory for Ph.D scholars

Compulsory Course Work:

- As per **UGC Minimum Standards** and Procedure for Award of Ph.D Degree Regulations 2020, a Ph.D scholar shall be required to undertake **course work for a minimum period of one semester** which is **compulsory pre-requisite for both full time and part time candidates**.

- It shall consist of one or more courses on **Research & Publication Ethics and Research Methodology** which shall cover areas such as quantitative methods, computer applications, research ethics and review of published research in the relevant field, training, and field work and other areas found relevant to the discipline concerned. Other courses shall be advanced level areas in the subjects concerned for enabling the students to acquire deep knowledge in the preparation for Ph. D degree.

- All the candidates admitted to the Ph. D programme shall be required to complete the Ph. D course work prescribed by the Institute & respective Department during the initial / first semester. **Research Supervisor along with Research Advisory Committee shall prescribe the courses** and recruit faculty to teach candidates prescribed courses.

- The concerned Department must be involved in teaching of Course Work, especially related to selection of Title and preparation of Synopsis.

- A candidate will complete his Course Work of **six months through intensive classes**, assignments, review of literature, short studies under the recognized Supervisor & Research Advisory Committee.

- After the completion of Course Work, **examination will be conducted by Examination section** of the Institute. In case candidate fails or drops in examination, one more chance will be given for the compulsory Course Work Examination.

- However, if the student is not in a position to complete the course work in the prescribed time limit as above, due to genuine reasons, may file an appeal and on the recommendation of the Research Advisory Committee, the Dean may grant extension up to additional one semester. Failing to complete the course work within the extended period (within first year of admission) may lead to cancellation of candidature.

- Scholars admitted to the Ph.D programme shall be required to complete the course work prescribed by the respective departments during the initial one year from the date of registration, failing which the registration shall be automatically cancelled.

Ph. D Course Work

Scheme and Syllabus

COMPULSORY			
Sl. No	**Course Code**	**Course Title**	**Credit**
1.	20RPE01	RESEARCH AND PUBLICATION ETHICS (RPE)	2
2.	20RRM02	RESEARCH METHODOLGY	2
ELECTIVE ADVANCE LEVEL (Any Two)			
4.	20RME 01	ELECTIVE-1	4
5.	20RME 02	ELECTIVE-2	4
6.	20RME 03	ELECTIVE-3	4
7.	20RME 04	ELECTIVE-4	4

Scheme of Examination and Passing:

- This course will have 100% external (Institution written examination of 3 hours duration for each course paper). All external examinations will be held at the end of course work and will be conducted by the Institute as per the existing norms.
- Each question paper will be of 100 Marks.
- Each question paper will consist of 10 questions of 20 marks each and student should answer **Any Five questions** out of 10 questions.

Standard point scale for grading:

Grade	Marks	Grade Points
O	70 & above	7
A	60-69.99	6
B	55-59.99	5
C	50-54.99	4
D	45-49.99	3
E	40-44.99	2
F(Fail)	39.99 & below	1

A Ph.D. scholar has to obtain a **minimum of 55% of marks** or its equivalent grade in the UGC7- point scale (or an equivalent grade/CGPA in a point scale wherever grading system is followed) in the course work in order to be eligible to continue in the program and submit the dissertation/thesis.

01	20RPE01	RESEARCH AND PUBLICATION ETHICS (RPE)	
Exam Hours: 03		Exam Marks: 100	Credit-2 (30Hrs)

Module – 1 Philosophy and ethics:(4Hrs)

l. Introduction to philosophy: definition, nature and scope, concept, branches

2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

Module – 2 Scientific conduct: (4Hrs)

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

Module – 3 Publication ethics: (7Hrs)

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WA-ME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributor ship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

Module – 4

Open access publishing:(4Hrs)

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Module – 5

Publication misconduct: (4Hrs)

A. Group Discussions **(2Hrs)**

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

B. Software tools **(2Hrs)**

Use of plagiarism software like Turnitin, Urkund and other open source software tools

Databases and research metrics(7Hrs)

A. Databases**(4Hrs)**

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics**(3Hrs)**

1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
2. Metrics: h-index, g index, i10 index, altmetrics

Question paper pattern:

- The question paper will have Ten questions.
- Each full question consists of 20 marks.
- There will be 2 full question (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Reference Books:

1. Bird, A (2006). Philosophy of science. Routledge.
2. MacIntyre, Alasdair (1976),A Short History of Ethics, London.
3. Chaddah,P (2018), Ethics in Competitive Research: Do not get scooped: Do not get Plagiarized,ISBN:978-9387480865.
4. National academy of science, National Academy of Engineering and Institute of Medicine (2009) on being a scientist: A guide to Responsible Conduct Research, Third Edition, National academic press.
5. Resnik DB(2011).What is ethics in research &why it's important, National institute of Environmental Health Science ,1-10.
6. Beall, J (2012), Predatory publishers are corrupting open access. Nature,489(7415).
7. Indian national science academy (INSA)Ethics in Science educations Research and governance (2019)ISBN:978-81-939482-1-7.

.

02	20RRM02	RESEARCH METHODOLGY	
Exam Hours: 03		**`Exam Marks: 100**	**Credit-2 (30Hrs)**

Module – 1 (4Hrs)

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Module – 2(4Hrs)

Reviewing the literature: Place of the literature review in research, bringing clarity and focus to research problem, improving research methodology, broadening knowledge base in research area, Enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Module – 3 (6Hrs)

Design of Sample Surveys: Design of Sampling: Introduction, Sample Design, Sampling and Non-Sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale. Data Collection: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Module – 4(6Hrs)

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.

Module – 5(10Hrs)

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organization (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and

Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property

Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg New Age International 4th Edition, 2018.
2. Research Methodology a step-by step guide for beginners. (For the topic Reviewing the literature under module 2), Ranjit Kumar SAGE Publications Ltd 3rd Edition, 2011.

Reference Books:

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