CURRICULUM STRUCTURE

FINAL YEAR UG: B.E.

MECHANICAL ENGINEERING

REVISION: FRCRCE-1-24

Effective from Academic Year 2024-25
Board of Studies Approval: 9/03/2024
Academic Council Approval: 16/03/2024

Dr. DEEPAK BHOIR
Dean Academics

Dr. BHUSHAN T. PATIL
Head of Department

DR. SURENDRA RATHOD
Principal

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

<u>Preamble:</u>

Greetings and congratulations to all the education partners Fr Conceicao Rodrigues College of Engineering for getting autonomous status to the college from the year 2024-25. University Grant Commission vide letter No. F. 2-10/2023(AC-Policy) dated 23rd Nov 2023 conferred the autonomous status to Fr. Conceicao Rodrigues College of Engineering, Fr. Agnel Ashram, Bandstand, Bandra (West), Mumbai 400050 affiliated to University of Mumbai for a period of 10 years from the academic year 2024-2025 to 2033-2034 as per clause 7.5 of the UGC (Conferment of Autonomous Status Upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) Regulations,2023. We look towards autonomy as a great opportunity to design and implement curriculum sensitive to needs of Learner, Indian Society and Industries.

All India Council for Technical Education (AICTE) has made implementation of Internship policy mandatory for students. While applying for Extension of Approval (EoA) it is desired that institute has already implemented compulsory internship for all final year students.

The National Education Policy (NEP), 2020 suggests that students must actively engage with the practical side of their learning as part of a holistic education to further improve their employability. It states that students at all HEIs will be provided with opportunities for internships with local industry and businesses as well as research internships with faculty and researchers at their own or other HEIs/research institutions. In line with the NEP and tracing the provisions of NcrF, Government of Maharashtra has subsequently released two Government Resolutions (GRs) (NEP GR dated – 1. 20 April 2023, and 2. 4 July 2023) to reinforce NEP implementation and credit revision across Maharashtra HEIs. These GRs lay out detailed guidelines for curriculum interventions.

Fr. CRCE has taken a strategic move as a response to the NEP's call for students to engage with practical learning through internships, a practice proven to enhance employability and refine skill sets for the final year students from academic year 2024-25.

Following two major changes applicable for Final Year Students of 2024-25 and 2025-26 batch:
1. Semester long internship option
2. Revised assessment in the form of ISE-1, MSE, ISE-2 and ESE to be taken by the college.

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Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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I. Internship:

Following are the objectives of the Internships envisaged for the students:

- ✓ Exposing students to industrial environments that cannot be replicated in a classroom or lab.
- ✓ Providing opportunities to acquire and refine analytical and managerial skills crucial for a professional career.
- ✓ Offering hands-on experience in teamwork, thereby enhancing professional skills like communication, work ethics, conflict resolution, etc., with a lasting impact on lifelong learning and professional development.
- ✓ The general idea is to enable students to undertake immersive assignments within the organizations for a limited period.
- ✓ Establishing links between students and potential future job or research opportunities.

Methodology of Implementation of Internship Policy for Final Year Students of 2024-25:

A. Completion of Existing Credits:

1. Semester VIII will be conducted in Fast Track Mode during first week of July and winter vacation for completing Institute Level Elective common course to all the departments.
2. Each course will be conducted in a continuous training format for 10days (3hrs theory+2hours lab).
3. Honors course will be taken for two hours each day during Fast Track Mode.
4. Major project will be continued till the official semester end. Assessment of major project will be conducted in phase-wise manner. Students need to compulsorily present in person for each of the phases of assessment.
5. If required then provision for SWAYAM courses to be explored by departments
6. Assessments to be completed immediately after completion of all courses.
7. Release of Gazette and score cards will be only at the end of academic year

B. Internship Details:

1. Training and placement department shall contact companies and strive for providing Six months internship to all the students. Preference should be given to Internship+PPO during regular placement cycle in SEM VII.
2. Internships should be an integral part of the academic curricula. But for 2024-25 and 2025-26 batch of Final Year students, credit framework is already given by University of Mumbai. For student of these batches internship is last moment value addition and therefor it will not be a part of credit

2

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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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framework. College is providing this as an additional experiential learning opportunity for the students by considering Market demand, Industry demand, Government Resolutions and Student desire.

3. Following are the types of internship opportunities that can be explored by students:

    a. Offered by Industry Govt./ NGO/MSME

    b. Research Institutes like BARC, TIFR, SAMEER and IITs

    c. At various Incubation Centres

    d. Internships offered through academic collaborations with Foreign Universities

    e. Internships offered by reputed colleges with whom MoUs are signed for the collaboration and credit exchange

    f. Or any other internship approved by HoI based on the merit of offer

4. All internships are subjected to approval of Head of the Institute. Students must take prior approval from college before starting internship

5. Students opting for Entrepreneurship or Start-up are exempted from internship; however, they have to work in the pre-incubation centre of the college to work for their start-up initiative with demonstrable output.

6. Students who wish to work on academic / industry research project (Rather than other internships) assigned under a faculty of Fr CRCE is allowed to do so provided details of work to be done and outcomes are clearly stated and approved by the college authorities.

7. Students can proceed for Internships from 15th Jan.

8. On the request of student college will issue successful completion certificate after achieving predefined approved milestones of Internship/Entrepreneurship/Research Project etc.

Student Resources:
Government Internship Programs:
- ✓ AICTE Internship: https://internship.aicte-india.org/
- ✓ NITI Ayog Internship: https://www.niti.gov.in/internship
- ✓ TULP Internship Program: https://smartcities.gov.in/The_Urban_Learning_Internship_Program
- ✓ Digital India Internship: https://www.meity.gov.in/writereaddata/files/Digital%20Internship%20Scheme%202023%20%281%29.pdf
- ✓ Directorate General of Foreign Trade Internship program: https://www.dgft.gov.in/CP/?opt=intership-scheme
- ✓ National Commission for Scheduled Tribes Internship: https://ncst.nic.in/sites/default/files/2021/Internship/3677
- ✓ Corporate Affairs Ministry Internship program: https://www.mca.gov.in/bin/dms/getdocument?mds=aC%252B%252F82boz%252FD%252FdHcFkAAJ0A%253D%253D&type=open
- ✓ Finance Ministry Internship program: https://dpe.gov.in/schemes/scheme-internship

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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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✓ Women and Child Development Ministry Internship program:
https://wcd.nic.in/sites/default/files/Internship%20Guideline.._0.pdf

✓ Ministry of Culture Internship programs: https://nationalmuseumindia.gov.in/en/national-museum-internship-programme

Online Platforms for Internships:
✓ Internshala: https://internshala.com/
✓ LetsIntern: https://letsintern.in/
✓ Twenty19: http://twenty19.com.testednet.com/
✓ HelloIntern: https://hellointern.co/
✓ Freshersworld: https://www.freshersworld.com/
✓ Youth4work: https://www.youth4work.com/
✓ Freshersnow: https://www.freshersnow.com/internships-in-delhi/
✓ Zuno by Foundit: https://www.foundit.in/zuno/
✓ LinkedIn: https://www.linkedin.com/jobs/internship jobs/?currentJobId=3647611763&originalSubdomain=in
✓ Well Found (earlier, AngelList Talent): https://wellfound.com/location/india
✓ Indeed: https://in.indeed.com/jobs?q=internships&l=&vjk=fd2d4f96a2564717
✓ Naukri.com: https://www.naukri.com/internship-jobs
✓ TimesJobs: https://www.timesjobs.com/jobs-by-roles/intern-jobs
✓ NGO Box: https://ngobox.org/job_listing.php
✓ CSR Box: https://csrbox.org/

II. Honours and Minor Degree Eligibility Criteria for Students:

i. Following is the eligibility criteria for students opting the Honours/ Minor Degree program:

a. Students with no backlog in semester I, II, and III

b. The CGPI (based on semester I, II, and III) of the students must be 6.75 and above

c. For direct second year (DSE) admitted students - No backlog in semester III and CGPI must be 6.75 and above

ii) Each eligible student can opt for maximum one Honour's or one Minor Programs at any time.

iii) However, it is optional for leaners to take Honours/Minor degree program.

iv) The Honours/ Minor degree program can be opted only during regular engineering studies

v) The student have to complete the Honours/ Minor degree program in stipulated four semesters only.

<u>Note:</u>

1. Courses offered during internship semester shall be in online mode
2. Technical support team for registration of Academic Bank of Credits (ABC), registration of elective/optional courses, registration of online courses, registration for degree options etc. under supervision of Dean Academics.

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Fr. Conceicao Rodrigues College of Engineering

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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SEMESTERWISE CURRICULUM STRUCTURE

FINAL YEAR Mechanical Engineering Program:

	SEM-VII									
Course Code	Course Name		Contact Hours	Examination Marks					Credits
				ISE1	MSE	ISE2	ESE	Total	Total
MEC701	Design of Mechanical System	TH	4	20	30	20	30	100	4
MEC702	Logistics and Supply Chain Management	TH	3	20	30	20	30	100	3
MEDLO703X	Department Level Optional Course – 3	TH	3	20	30	20	30	100	3
MEDLO704X	Department Level Optional Course – 4	TH	3	20	30	20	30	100	3
ILO701X	Institute Level Optional Course – I*	TH	3	20	30	20	30	100	3
MEL701	Design of Mechanical System	PR	2	20	--	30	--	50	1
MEL702	Maintenance Engineering	PR	2	20	--	30	--	50	1
MEL703	Industrial Skills	PR	2	20	--	30	--	50	1
MEP701	Major Project I	PR	6#	10	--	20	20	50	3
	Total		**TH:TU:PR 16:0:12**					**700**	**22**

# indicates work load of Learner (Not Faculty), for Major Project

* Common with all branches

Department Level Optional Courses:

Department Level Optional Course – 3 (MEDLO703X)	Department Level Optional Course – 4 (MEDLO704X)
1. Automotive Power Systems	1. Machinery Diagnostics
2. Renewable Energy Systems	2. Vibration Controls
3. Vehicle Systems	3. Advanced Vibration

	SEM-VIII									
Course Code	Course Name		Contact Hours	Examination Marks					Credits
				ISE1	MSE	ISE2	ESE	Total	Total
MEC801	Operations Planning and Control	TH	3	20	30	20	30	100	3
MEDLO805X	Department Level Optional Course – 5	TH	3	20	30	20	30	100	3
MEDLO806X	Department Level Optional Course – 6	TH	3	20	30	20	30	100	3
ILO802X	Institute Level Optional Course – 2*	TH	3	20	30	20	30	100	3
MEL801	Product Design and Development	PR	2	20	--	30	--	50	1
MEL802	Laboratory based on IoT	PR	2	20	--	30	--	50	1
MEP802	Major Project II	PR	12#	20	--	30	100	150	6
	Total		**TH:TU:PR 12:0:16**					**650**	**20**

# indicates work load of Learner (Not Faculty), for Major Project

* Common with all branches

Department Level Optional Courses:

Department Level Optional Course – 5 (MEDLO805X)	Department Level Optional Course – 6 (MEDLO806X)
1. Composite Materials	1. Product Design and Development
2. Smart Materials	2. Design for X
3. Micro Electro Mechanical Systems	3. Total Quality Management

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Institute Level Optional Courses:

Course Code	Institute Level Optional Course – I* (ILO701X)	Course Code	Institute Level Optional Course – II* (ILO802X)
ILO7011	Product Lifecycle Management	ILO8021	Project Management
ILO7012	Reliability Engineering	ILO8022	Finance Management
ILO7013	Management Information System	ILO8023	Entrepreneurship Development and Management
ILO7014*	Design of Experiments	ILO8024	Human Resource Management
ILO7015	Operation Research	ILO8025	Professional Ethics and CSR
ILO7016	Cyber Security and Laws	ILO8026	Research Methodology
ILO7017	Disaster Management and Mitigation Measures	ILO8027	IPR and Patenting
ILO7018	Energy Audit and Management	ILO8028	Digital Business Management
ILO7019	Development Engineering	ILO8029	Environmental Management

* ILO7014 is offered to branches other than B. E. (Mechanical)

Society of St. Francis Xavier, Pilar's

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Honors Degree Offered to Mechanical Engineering Students from SEM-V to SEM-VIII:

A. Name: Robotics
1. SEM-V: HRBC501: Industrial Robotics
2. SEM VI: HRBC601: Mechatronics & IoT
3. SEM VII: HRBC701: Artificial Intelligence & Data Analysis
4. SEM VII: HRBSBL701: Robotics and Automation Lab
5. SEM VIII: HRBC801: Autonomous Vehicle Systems

B. Name: 3D Printing
1. SEM-V: H3DPC501: Introduction to CAD
2. SEM VI: H3DPC601: 3D Printing: Introduction & Processes
3. SEM VII: H3DPC701: Applications of 3D Printing
4. SEM VII: H3DPSBL701: Skill Based Lab– Digital Fabrication
5. SEM VIII: H3DPC801: 3D Printing in Medical Technology

C. Name: Data Science
1. SEM-V: HDSC501: Mathematics for Data Science
2. SEM VI: HDSC601: Statistical Learning for Data Science
3. SEM VII: HDSC701: Data Science for Health and Social Care
4. SEM VII: HDSSBL701: Data Science for Health and Social Care Lab
5. SEM VIII: HDSC801: Text, Web and Social Media Analytics

D. Name: Internet of Things
1. SEM-V: HIoTC501: IoT Sensor Technologies
2. SEM VI: HIoTC601: IoT System Design
3. SEM VII: HIoTC701: Dynamic Paradigm in IoT
4. SEM VII: HIoTSBL701: Interfacing & Programming with IoT Lab (SBL)
5. SEM VIII: HIoTC801: Industrial IoT

Minors Degree Offered to Mechanical Engineering Students from SEM-V to SEM-VIII:

A. Name Artificial Intelligence and Machine Learning
1. SEM-V: HAIMLC501: Mathematics for AI & ML
2. SEM VI: HAIMLC601: Game Theory using AI & ML
3. SEM VII: HAIMLC701: AI & ML in Healthcare
4. SEM VII: HAIMLSBL701: AI & ML in Healthcare: Lab
5. SEM VIII: HAIMLC801: Text, Web and Social Media Analytics

B. Name: Blockchain
1. SEM-V: HBCC501: Bit coin and Crypto currency
2. SEM VI: HBCC601: Blockchain Platform
3. SEM VII: HBCC701: Blockchain Development
4. SEM VII: HBCSBL701: Private Blockchain Setup Lab (SBL)
5. SEM VIII: HBCC801: DeFi (Decentralized Finance)

C. Name: Cyber Security
1. SEM-V: HCSC501: Ethical Hacking
2. SEM VI: HCSC601: Digital Forensic
3. SEM VII: HCSC701: Security Information Management
4. SEM VII: HCSSBL601: Vulnerability Assessment Penetration Testing (VAPT) Lab
5. SEM VIII: HCSC801: Application Security

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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
		4	--	--		4	--	--	4
MEC701	Design of Mechanical System	Examination Scheme							
		ISE1		MSE	ISE2	ESE		Total	
		20		30	20	100 (30% weightage)		100	

Pre-requisite Course Codes		Engineering Mechanics, Strength of Materials, Machine Design
Course Outcomes	CO1	Apply the concept of system design.
	CO2	Select appropriate gears for power transmission on the basis of given load and speed
	CO3	Design material handling systems such as hoisting mechanism of EOT crane,
	CO4	Design belt conveyor systems
	CO5	Design engine components such as cylinder, piston, connecting rod and crankshaft
	CO6	Design pumps for the given applications

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Methodology & Morphology of design, Optimum design, system concepts in design.	1-6	4
2	2.1	**Design of Transmission Gear Box:** Single stage and Two stage Gear box with fixed ratio consisting of Design of spur, helical, bevel and worm and worm wheel gear pairs, Gear box housing layout and housing design.	1-6,17	12
3	3.1	**Design of Hoisting Mechanism:** Design of Snatch Block Assembly including Rope Selection, Sheave, Hook, Bearing for hook, cross piece, Axle for sheave and shackle plate, Design of rope drum, selection motor with transmission system.	1-6, 11	10
4	4.1	**Design of Belt Conveyors:** Power requirement, selection of belt, de-sign of tension take up unit, idler pulley	1-6, 11	4
5	5.1	**Engine Design (Petrol and Diesel):** Design of cylinder, Piston with pin and rings, connecting rod & crank shaft with bearings	1-6, 18	10
6	6.1	**Design of Pump:** Design of main components of gear pump. 1 Motor selection 2 Gear design 3 Shaft design and bearing selection	1-6,16	8

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		4 Casing and bolt design 5 Sizing of design of suction and delivery pipe		
	6.2	**Design of main components of Centrifugal Pump:** 1 Motor selection 2 Suction and Delivery pipe 3 Design of Impeller, Impeller shaft 4 Design of Volute Casing	1-6,16	
				48

Recommended Books:

1 "Machine Design Exercises", S.N.Trikha - New Delhi Khanna Publisher 1978.

2 "Mechanical Engineering Design", Shigley J E and Mischke C R,11th Edition 2019, McGraw Hill, ISBN: 9788184956207.

3 "Mechanical design analysis", MF Spotts, 3rd Edition, Prentice Hall Inc.

4 "Design of Machine Elements", Bhandari VB,5th Edition 2020, TMH,ISBN: 9789390177479

5 "Machine Design", Black PH and O Eugene Adams, 3rd Edition, McGraw Hill
ISBN 10: 0070055246

6 "Design Data", P.S.G. College of Technology, Coimbatore. ISBN: 978-8192735504

7 "Engineering Design", Dieter G E, McGraw Hill Inc, ISBN: 9781260113297

8 "Mechanical System Design", SP Patil, 2nd Edition., JAICO Publishing House ISBN: 978-8179923153

9 "Material Handling Equipment", Rudenko,2nd Edition, M.I.R. publishers, Moscow

10 "Machine Design-An Integrated Approach", Robert L. Norton,6th Edition, Pearson Education, ISBN: 9780135184233

11 "Material Handling Equipments", N. Rudenko, Peace Publication

12 "Material Handling Equipments", Alexandrov,5th Edition, Mir Publication ISBN: 9780714717456

13 Machine Desgin", Reshetov, Mir Publication 1978.

14 "Machine Design", R.C.Patel, Pandya, Sikh, Vol -I & II,12th Edition, C. Jamnadas& Co.

15 "Design of Machine Elements", 4th Edition, V. M. Faires, ISBN: 978-0023359507

16 "Pumps: Theory, Design and Applications", G K Sahu, New Age International 2000 ISBN: 9788122412246

17 "Gear Design Handbook", GitinMaitra, 2nd Edition, ISBN: 978-0074602379

18 "Design Data Book- Design of engine parts",Khandare S.S & Kale A.V, 2nd Edition, ISBN: 978-9352654260

Links for online NPTEL/SWAYAM courses:

1. https://onlinecourses.nptel.ac.in/noc22_me62 - Gear And Gear Unit Design: Theory and Practice, IIT Kharagpur

2. https://nptel.ac.in/courses/112/106/112106137/ - Machine Design-II, IIT Madras

Course Assessment:
Theory:

> **ISE-1:** Quiz (20 marks)
> **ISE-2:** Quiz (20 marks)
> **MSE:** Two hours 30 Marks written examination based on 50% syllabus
> **ESE:** Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Society of St. Francis Xavier, Pilar's
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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
MEC702	Logistics and Supply Chain Management	3	--	--		3	--	--	3
		Examination Scheme							
		ISE1	MSE	ISE2	ESE			Total	
		20	30	20	100 (30% weightage)			100	

Pre-requisite Course Codes		-	
Course Outcomes	CO1	Demonstrate a sound understanding of Logistics and Supply Chain Management concepts and their role in today's business environment.	
	CO2	Identify the drivers of supply chain performance and risks in supply chain management.	
	CO3	Apply various techniques of inventory management and rank the items using inventory management technique	
	CO4	Apply various strategies and techniques to minimize overall logistics cost	
	CO5	Understand the role of digitization in supply chain management leading to sustainability	
	CO6	Apply various mathematical models/tools to design the supply chain network	

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Introduction: Objectives of a Supply Chain Management, Stages of Supply chain, Value Chain Process, Cycle view of Supply Chain Process, Key issues in SCM, logistics & SCM, Supply Chain Drivers /decisions and obstacles, Supply chain strategies, strategic fit, Best practices in SCM, Obstacles of streamlined SCM. Supplier Selection, Supplier quality audits, Contract management, Non-Disclosure Agreement (NDA), Make & Buy Decision while in-out sourcing	3	5
2	2.1	**Supply Chain Performance:** Bullwhip effect and reduction, Performance measurement: Dimension, Tools of performance measurement, SCOR Model. Demand chain management, Global Supply chain- Challenges in establishing Global Supply Chain, Factors that influences designing Global Supply Chain Network.	3	9
	2.2	Supply Chain Risk Management (Risks involved in supply chain which includes – Supplier Financial Risk, Performance Risk, Compliance Risk, Country specific Risk, Cyber Security.	3,7	

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	2.3	Supplier performance measurement – (Delivery & Quality performance, schedule adherence, Goods receipt compliance etc), Supplier Capacity Analysis, Supplier Score card.	1,7	
3	3.1	**Inventory management:** Definition of Inventory, Inventory types & functions; EOQ Model and Buffer Stock, Assumptions, Instantaneous Replenishment case, Demand and production rate are different, when backorders are allowed, Buffer Stock and ROL. Replenishment systems (Q and P system) Inventory Control- ABC Analysis, Numerical problems on ABC analysis, VED Analysis		6
4	4.1	**Logistics Management and outsourcing:** Evolution, Objectives, Components and Functions of Logistics Management, Distribution related Issues and Challenges; Gaining competitive advantage through Logistics Management, Transportation- Functions, Costs, and Mode; Network and Decision, Containerization, Cross docking.	3	8
	4.2	Warehousing: Concept and types, Warehousing strategy, Warehouse facility location & network design Part Packaging, Use of Returnable pallets, ASN – Advance Shipment Notification.	7	
	4.3	Reverse logistics: Outsourcing - Nature and concept, Strategic decision to Outsourcing, Third party logistics(3PL), Fourth party logistics(4PL), Cold chain operations in Supply chain.	1,7	
5	5.1	**Digitization in supply chain Management and Sustainability:** IT in supply chain - Role of IT in a supply chain, The supply chain IT framework, Application of Bar coding, Significance of SAP/RFID, The future of IT in the supply chain, Supply chain IT in practice, TMS (Transport Management System), WMS (Warehouse Management System)	7	4
	5.2	Green supply chain management, Supply Chain sustainability, Supply Chain sustainability index measurement with case studies.	1	
	5.3	Social aspects of supply chain (CSR), Environment aspects of supply chain (CO_2 emission), resource utilization, recycling.		
6	6.1	**Supply Chain Network Design:** Factors influencing distribution network design, Supply chain resilience, Design options for distribution network, Introduction to mathematical modelling, considerations in modelling SCM systems,	3	7
	6.2	Overview of the models, Models on transportation, Transportation problem, Vehicle routing problem, Travelling salesman problem, Capacitated transhipment problem, shortest path problem.	3	
	6.3	Value Stream Mapping (VSM), Order Fulfillment Process Flow, understanding the terms related to Supply chain- Lead Time, Takt Time, Minimum Order Quantity (MOQ), Manufacturing Critical Path Time (MCT)	3,7	
Total				**39**

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Recommended Books:

1. R.P. Mohanty, S.G. Deshmukh, "Essentials of Supply Chain management", 1st Edition 2004, Jaico Publishing House.
2. S.K. Bhattacharya, "Logistics Management", 3rd Edition, Pearson Publication ISBN: 9788131768624
3. Sunil Chopra, P. Meindl, "Supply Chain Management", 6th Edition 2016, Pearson Education Asia.
4. Martin Christopher, "Logistics and Supply Chain Management",4th Edition 2010, Pitman Publishing.
5. Bowon Kim, "Supply Chain Management in Mastering Business in Asia", Edition 2005, John Wiley & sons (Asia) Pvt Ltd, ISBN: 978-0470821404
6. Michael Hugos, "Essentials of Supply Chain Management", 4th Edition 2018, John Wiley and Sons, ISBN: 9781119461104
7. Rahul V Altekar, "Supply Chain Management: Concepts and cases", Edition 2009, PHI, ISBN: 9788120328594.
8. D. Simchi-Levi, P. Kaminsky, E. Simchi-Levi, and Ravi Shankar, "Designing and Managing the Supply Chain concepts, Strategies and Case studies", 3rd Edition, Tata McGraw Hill, New Delhi, 2008.

Links for online NPTEL/SWAYAM courses:
1. https://onlinecourses.nptel.ac.in/noc22_mg74/preview
2. https://onlinecourses.swayam2.ac.in/cec22_mg22/preview

Course Assessment:
Theory:
    ISE-1: Quiz (10 marks) and case studies (10 marks)
    ISE-2: Assignments (20 marks)
    Continuous pre-defined rubrics-based evaluation
    MSE: Two hours 30 Marks written examination based on 50% syllabus
    ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

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		L	T	P		L	T	P	Total
MEDLO7031	Automotive Power Systems	3	--	--		3	--	--	3
		Examination Scheme							
		ISE1	MSE	ISE2	ESE			Total	
		20	30	20	100 (30% weightage)			100	

Pre-requisite Course Codes		-
Course Outcomes	CO1	Demonstrate the working of Fuel supply and ignition system of I.C. engines
	CO2	Illustrate the working of lubrication, cooling and supercharging systems.
	CO3	Comprehend the different technological advances in engines and alternate fuels
	CO4	Identify and describe the history and different EV/HEV drivetrain topologies
	CO5	Compare and evaluate various energy sources and energy storage components for EV and HEV application.
	CO6	Comprehend EV and HEV working through Case studies.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Constructional Features of I.C. Engines. Parts of I.C. engine and their materials. **Fuel Supply System :** Fuel-Air ratio, Fuel air mixture requirement, Conventional fuels used in IC engines, Fuel injection system in SI and CI engine and MPFI Engine.	1,2,3,5,6	8
	1.2	**Ignition System :** Battery Ignition System, Magneto Ignition System, Functions and working of ignition coil, spark plug, contact breaker point, Requirements and working of Ignition advance mechanisms; mechanical and vacuum, Electronic Ignition Systems; Capacitor Discharge Ignition System, Transistorized Coil Assisted Ignition System, Transistor Ignition system with contactless breaker.	1,2,3,5,6	
2	2.1	**Lubrication System :** Types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems	1,2,3,5,6	6
	2.2	**Cooling System :**	1,2,3,5,6	

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Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling		
	2.3	**Supercharging/Turbocharging :** Objectives, Limitations, Methods and Types, Different arrangements of turbochargers and superchargers (No Numericals)	1,2,3,5,6	
3	3.1	**Engine Exhaust Emission and its control** Constituents of exhaust emission at its harmful effect on environment and human health, Formation of NOx, HC, CO and particulate emissions, Methods of controlling emissions; Catalytic convertors, particulate traps, Exhaust Gas Recirculation, EURO and BHARAT norms.	1,2,3,5,6	8
	3.2	**Alternative Fuels** Alcohol - Hydrogen - Natural Gas and Liquefied Petroleum Gas – Biodiesel- Biogas - Producer Gas - Properties - Suitability - Engine Modifications - Merits and Demerits as fuels.	1,2,3,5,6	
	3.3	**Basics of Electronic Engine Controls:** Electronic Control module (ECM), Inputs required and output signals from ECM, Sensors: Throttle Position, Inlet Air Temperature, Coolant Temperature, Crankshaft Position, Camshaft Position, Mass Air flow and Exhaust Gas Oxygen sensors, their construction and importance in ECM. Electronic Spark control, Air Management system, Idle speed control	1,2,3,5,6	
4	4.1 4.2	**Introduction to Hybrid and Electric Vehicles:** History of Electric Vehicles (EV) and Hybrid electric vehicles (HEV), need and importance of EV and HEV, Indian and Global Scenario of EV and HEV.	4,7,8	6
		Drivetrain topologies: Electric traction and hybrid traction system, Electric drive topologies, hybrid drivetrain topologies.	4,7,8	
		Power energy supply requirement for EV/HEV applications.		
5	5.1	Electric Drives and controller: Electric system components for EV/HEV, AC and DC motor drives, RPM and Torque calculation of motor, Motor Controllers,	4,7,8	5
6	6.1	**Energy Sources for EV/HEVs:** Requirement of energy supplies and storage in EV/HEV, Types of batteries(Lead Acid/Li-ion/NiMH) and its working, battery specifications, Battery Management system; Fuel cells, flywheels and ultra-capacitors as energy sources for EV/HEV, Concept of Hybridisation for different energy sources.	4,7,8	6
	6.2	**Energy Management Strategies:**	4,7,8	

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		EV/HEV energy management strategies, classification and comparison of various energy management strategies		
	6.3	**Battery charging:** Type of battery charging systems, Selection and Sizing of charging station, Components of charging station. Single line diagram of charging station, On board Charger. Payback period of EV and HEV	4,7,8	
	6.4	**Case Study: Toyota Prius, Honda Insight, Tata Nexon EV**		
Total				**39**

Recommended Books:

Text Books:

1. A Course on Internal Combustion Engine,Mathur and Sharma,Dhanpat Rai & Sons,New Delhi,2001.

2. Internal Combustion Engine,V.Ganesan,Mc Graw Hill,1995

3. Internal Combustion Engine, Domkundwar & Domkundwar,Dhanpat Rai & Sons,New Delhi,2013.

4. Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, CRC Press,2005

Reference Books:

1. Fundamental of Internal Combustion Engines,Gill and Smith,Oxford & IBH Publishing Company Pvt.ltd,2007

2. Internal Combustion Engine Fundamentals,Heywood,McGraw Hill,1988

3. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press,2003

4. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley,2003

Links for online NPTEL/SWAYAM courses:
1. https://nptel.ac.in/courses/107106088
2. https://nptel.ac.in/courses/112103262
3. https://nptel.ac.in/courses/108102121
4. https://nptel.ac.in/courses/108106170

Course Assessment:

Theory:
      ISE-1: Quiz (10 marks) and Assignments (10 marks)
      ISE-2: Article discussion and presentation (20 marks)
      MSE: Two hours 30 Marks written examination based on 50% syllabus
      ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	**T**	**P**		**L**	**T**	**P**	**Total**
		3	**--**	**--**		**3**	**--**	**--**	**3**
MEDLO7032	**Renewable Energy Sources**	**Examination Scheme**							
		ISE1	**MSE**		**ISE2**	**ESE**		**Total**	
		20	**30**		**20**	**100 (30% weightage)**		**100**	

Pre-requisite Course Codes		-
Course Outcomes	CO1	Describe the need for renewable energy and its potential for the development of a sustainable environment.
	CO2	Analyze different solar collectors using geometrical parameters and photovoltaics for generation of solar energy.
	CO3	Identify and analyze various wind turbine energy harnessment techniques.
	CO4	Design biogas plant for harnessing energy from organic waste.
	CO5	Describe significance of hydrogen energy to fulfill present and future energy needs.
	CO6	Describe the operating principle of geothermal energy and ocean energy and their role in sustainable development.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**1.1**	**Introduction to Renewable Energy Sources and Solar Radiation**: Global and National current energy scenarios, Prospects of renewable energy sources and renewable energies role in developing sustainable model.	1,2	5
	1.2	Solar radiation terms, solar geometry, earth sun angles, attenuation and measurement of solar radiation on horizontal and inclined surfaces, methods of solar radiation estimation.	1,2	
2		**Solar Thermal Energy:**		7
	2.1	Introduction and working principle of flat plate collectors, thermal performance analysis of flat plate collectors, concentrating collectors, Installation and maintenance criteria of solar thermal systems.	1,2,3	
	2.2	Solar thermal devices- Solar air heater and different types of solar air heaters, solar water heater and different types of solar water heaters, solar dryers, solar pond, solar distillation, solar still, solar cooker.	1,2,3	
	2.3	Solar space heating & cooling, solar refrigerator, solar thermal energy storage systems.	1,2,3	

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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	2.4	Case Study: Solar thermal power plant working operation.		
3		**Solar Photovoltaic Energy:**		7
	3.1	Introduction and working principle of a solar PV systems, types of solar PV cells, solar tracking systems, controls and measurement methods of solar PV systems.	4	
	3.2	Methods to improve the efficiency of PV cells, parameters which affect the efficiency and life cycle of PV cells.	4	
	3.3	Case Study: Installation of 1 kW of solar PV plant.		
4		**Wind Energy:**		6
	4.1	Basic components and working principle of wind energy conversion systems, wind data and site selection considerations, various types of wind energy conversion systems, constructional features of horizontal and vertical axis wind machines, performance analysis of horizontal and vertical axis wind machines.	5	
	4.2	Estimation of power output- betz limits, Environmental impacts of wind energy.	5	
5	**5.1**	**Energy from Biomass:** Introduction of bioenergy, conversion technologies, types of biogas generation plants, design and construction details of biogas plant (KVIC), site selection, digester design consideration, filling a digester for starting, maintaining biogas production, utilization of biogas.	1,2,10	7
	5.2	**Hydrogen Energy:** Introduction and application, General introduction to infrastructure requirement for hydrogen production, storage, dispensing & utilization.	1,2	
	5.3	Principles of fuel cells, types of fuel cells, power generation by fuel cells, applications of fuel cells.	1,2	
6	**6.1**	**Geothermal Energy:** Introduction to geothermal technologies and methods of extracting geothermal energy, prospects of geothermal energy in India.	1,2	7
	6.2	**Energy from the ocean:** Wave energy characteristics and wave energy conversion devices, tide energy conversion devices, Ocean Thermal Energy Conversion (OTEC) systems.	1,2	
	6.3	**Energy management and economics:** Energy conservation, energy security, energy economics, energy audit- definition, need, types of energy audit, Energy management (audit) approach-understanding energy costs,	1,2,3	
	6.4	Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating.	1,2,3	
Total				**39**

Recommended Books:

1. "Non-conventional Energy Sources", G.D. Rai, 6th Edition, Khanna Publishers, ISBN: 978-81-7409-073-7
2. "Renewable Energy: Power for a Sustainable Future", Edited by Godfrey Boyle, 3rd Edition 2012, Oxford University Press, ISBN: 978-0199681273
3. "Solar Energy: Principles of Thermal Collection and Storage", SP Sukhatme and J K Nayak, 4th Edition, Tata Mcgraw Hill Publishing Co. Ltd.

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4. "Solar Energy: Fundamentals and Applications", H.P. Garg& Jai Prakash, First Revised Edition, Tata McGraw-Hill Education.

5. "Wind Power Technology", Joshua Earnest, 2nd Edition, PHI Learning, 2015.

6. "Solar Engineering of Thermal Processes", John A . Duffie and William A Bechman, 4th Edition, Wiley Publications.

7. "Renewable Energy Sources", J W Twidell& Anthony D. Weir, 3rd Edition 2015,ELBS Pub, ISBN: : 978-1-315-76641-6

8. "Energy Conversion Systems", Rakosh Das Begamudre, New Age International (P) Ltd., Publishers, New Delhi, 2007, ISBN: 9788122412666

9. "Solar Photovoltaics: Fundamentals, Technologies and Applications", C S Solanki, 3rd Edition, PHI Learning.

10. "Biomass Regenerable Energy", D. D. Hall and R. P. Overend, John Wiley, New York, ISBN:047190919X

11. "Wind and Solar Power Systems", Mukund R Patel, 2nd Revised Edition, CRC Press, ISBN: 9780429114960

12. "Wind Energy Explained: Theory, Design and Application", J F Manwell, J.C. McGowan, A.L.Rogers,2nd Edition 2009, John Wiley and Sons.

Links for online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/103103206

2. https://nptel.ac.in/courses/103107157

3. https://nptel.ac.in/courses/115105127

Course Assessment:

Theory:

ISE-1: Quiz (20 marks)

ISE-2: Presentation on recent topics on smart materials (20 marks)

MSE: Two hours 30 Marks written examination based on 50% syllabus

ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Fr. Conceicao Rodrigues College of Engineering

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
MEDLO7033	Vehicle Systems	3	--	--		3	--	--	3
		Examination Scheme							
		ISE1	MSE	ISE2		ESE		Total	
		20	30	20		100 (30% weightage)		100	

Pre-requisite Course Codes		-	
Course Outcomes	CO1	Understand the working of different Vehicle Systems and Subsystems.	
	CO2	Understand the working of different Vehicle Electrical systems and subsystems.	
	CO3	Understand different Vehicle Body systems and layouts.	
	CO4	Illustrate working, functions of different vehicle mechanical, electrical, and chassis systems.	
	CO5	Understand the effect of aerodynamics on the functioning of a vehicle.	
	CO6	Comprehend the different technological advances in vehicle systems.	

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Power Flow Layout:** FE FWD,FE RWD,RE FWD,RE RWD, Underfloor Engine	1,5	8
	1.2	**Clutches:** Necessity of clutch in a automobile, Working and Construction of Single plate, Multi plate, Centrifugal, Semi Centrifugal, electromagnetic clutches, Fluid Flywheel	1,3,8	
	1.3	**Transmission:** Purpose and Elements of Gear Box, Characteristic Curves, Types-Sliding mesh, Constant Mesh, Synchromesh, Planetary Gear set, Torque Converter, Semi-Automatic and Automatic	1,3,8	
	1.4	**Drive Line:** UV joint, CV joint, Propeller Shaft construction and arrangement, Elements of drive line,2WD,4WD,Part time and Full time 2WD and 4WD.	1,3,8	
2	2.1	**Final Drive** Types of Final drive; spiral, bevel, Hypoid and worm drives.	1,3,8	8
	2.2	**Differential** Necessity of differential, Working of differential, Conventional and non-slip differential.	1,3,8	
	2.3	**Axles :**	1,3,8	

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Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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		Types of live axles; semi, three quarter and full floating axles. Types of Front Stub Axles; Elliot, Reverse Elliot, Lamoine and Reverse Lamoine		
	2.4	**Steering:** Requirement, Types of Steering Gear Box, Steering Geometry, Wheel Alignment and Wheel balancing, Power Steering	1,3,8	
	2.5	**Brakes:** Principle, Types; Hydraulic, Air, Electric, Exhaust, Regeneration ,Brake lining materials, ABS, EBD	1,3,8	
3	3.1	**Suspension:** Requirement and Types-Independent, Dependent, Air. Types of Shock absorbers ,Leaf spring types	1,3,8	6
	3.2	**Wheels and Tyres:** Tyre requirement, tire characteristics, Constructional detail, , tyre dimensions and specifications, Types of wheels and Hubs	1,3,8	
4	4.1	**AUTOMOTIVE ELECTRICAL SYSTEMS** **Batteries:** Construction, Types: Lead Acid, Alkaline,Nickel Metal Hydride, Lithium Ion, Battery Ratings, Battery Charging	5	8
	4.2	**Starting:** Requirement, Starter Motor Drives, cold cranking Amperes	5	
	4.3	**Charging:** Requirement, Principle and Construction of Dynamo and Alternator	5	
	4.4	**Ignition:** Mechanical and Electronic Ignition and Electronic Engine Control	5	
	4.5	**Lighting and Wiring:** Types of Lamps, Gauges, Cable Sizes, Color Codes, Multiplex Wiring systems	5	
	4.6	**Accessories:** Electric Horn, Wipers, Fuel Pumps, Power operated windows, Fuel Gauges, OBD systems	5	
5	5.1	**Body Engineering:** Chassis types and Structure types-Open, Semi Integral and Integral, Loads acting on chassis, Basic Dimensions and Visibility	2,4,6	6
	5.2	**Vehicle Aerodynamics :** Aerodynamic drag: Aerodynamic lift and Pitching moments, Side force, Yawing & Rolling moments.	6	
6	6.1	Recent Technological Developments in Automobile: Telematics, Intelligent Vehicles systems,V2V and V2I communication. Scope of AI in Automobile Vehicle	7	3
Total				**39**

Recommended Books:

Text Books:

1. Automobile Engineering, Kirpal Singh, Vol I & II, Standard publishers Distributors ,Delhi

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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2. J Powloski, "Vehicle Body Engineering", Business Books Ltd., London

3. Automobile Mechanics, N. K. Giri, 8thEdition, Khanna Publishers

4. P. L. Kohli, "Automotive Chassis & Body", Papyrus Publishing House, New Delhi.

5. Tom Denton,Automobile Electrical and Electronics System,Elsevier Third Edition,2003

Reference Books :

1. John Fenton, "Vehicle Body Layout & Analysis", Hutchinson, London.

2. Bosch Automotive HandBook, 6thEdition, SAE Publications

3. Automotive Mechanics by William H. Crouse and Donald L. Anglin, 10th Edition, McGraw Hill

Links for online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/107106088

2. https://nptel.ac.in/courses/107103084

3. https://nptel.ac.in/courses/113106082

Course Assessment:

Theory:

       ISE-1: Quiz (10 marks) and Assignments (10 marks)

       ISE-2: Case study / article discussion and presentation (20 marks)

       MSE: Two hours 30 Marks written examination based on 50% syllabus

       ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
		3	--	--		3	--	--	3
MEDLO7041	Machinery Diagnostics	Examination Scheme							
		ISE1	MSE	ISE2		ESE		Total	
		20	30	20		100 (30% weightage)		100	

Pre-requisite Course Codes		Industrial Electronics, Kinematics of Machinery
Course Outcomes	CO1	Relate basic concepts of Machinery Diagnostic.
	CO2	Describe the working of Vibration Measuring Instruments.
	CO3	Apply different Signal Processing Techniques in Vibration Measurement.
	CO4	Identify common faults in Machinery using Vibration Spectrum.
	CO5	Interpret the Vibration Signals for Monitoring and Prognosis.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Basics of Vibration** Periodic and random motion, Spectral Amplitude Scaling: RMS, Peak and Peak-to-Peak Conversion and Selection, Time and frequency domain analysis, Phase analysis, Orbit analysis, Understanding signal pattern, Importance of speed in accurate diagnosis, Importance of side bands in frequency spectrums.	1, Link	7
	1.2	**Introduction to Vibration based Condition Monitoring** Maintenance Principles, Vibration based fault Prognosis, Goal of Vibration Monitoring, Steps in Vibration Monitoring, Benefits of Vibration based condition monitoring.	1, Link	
2	2.1	**Vibration Measurement** Vibration measuring instruments: displacement, velocity, acceleration; Force measurement, Laser based measurements: laser vibrometer Sensor Selection Criteria , Sensor – Mounting Locations and Techniques	1, Link	7
3	3.1	**Data Acquisition & Signal Processing** Classification of signals, Signal analysis, Fast Fourier Transform (FFT), Essential Settings in Data Acquisition System (Plot Formats, Frequency Span and Frequency Resolution, Average Types and Number of Averages, Windowing, Spectrum Scaling), Signal conditioning	1, Link	7
4	4.1	**Machinery Fault Diagnosis I**	2,3	6

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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		Natural frequency and resonance tests (Practical approach), Time and Frequency domain analysis to identify unbalance, bent shaft, Misalignment, Soft foot conditions, Mechanical looseness		
5	5.1	**Machinery Fault Diagnosis II** Rolling element bearing and Journal Bearing fault diagnosis, Faults related to Gearbox, vane defects in pumps, Fault in Fans and Blowers.	2,3	6
6	6.1	**Applications of Condition Monitoring** Case studies related Balancing Problems in Turbines, Condition Monitoring in Sugar mills, Health Monitoring of Journal Bearing, Condition Monitoring of Industrial Pumps. (Aspects to be covered : Selection of sensors, recommended location of sensor, direction of measurement, selection of plot type, Data validation and Identification of Faults)	2,3	6
Total				**39**

Recommended Books:

1. R.B. Randall, "Vibration-based Condition Monitoring", Wiley2021, ISBN: 978-1-119-47755-6
2. A.R. Mohanty, "Machine Condition Monitoring: Principles and Practices", CRC Press 2017, ISBN: 9781138748255
3. R.A. Collacott, "Mechanical Fault Diagnosis and Condition Monitoring",1st Edition, Chapman and Hall, ISBN: 978-94-009-5723-7
4. J.S. Rao, "Vibratory Condition Monitoring of Machine", Narosa Publishing House.

Links for online NPTEL/SWAYAM courses:

https://nptel.ac.in/courses/112105232 – Machinery Fault Diagnosis and Signal Processing, IIT, Kharagpur

Course Assessment:
Theory:
> **ISE-1:** Assignments (10 marks, Quiz (10 marks)
> **ISE-2:** Assignments (10 marks, Quiz (10 marks)
> **MSE:** Two hours 30 Marks written examination based on 50% syllabus
> **ESE:** Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
		3	--	--		3	--	--	3
MEDLO7042	Vibration Controls	Examination Scheme							
		ISE1	MSE		ISE2	ESE		Total	
		20	30		20	100 (30% weightage)		100	

Pre-requisite Course Codes		Engineering Mathematics-II & III, Kinematics of Machinery
Course Outcomes	CO1	Apply basic concepts of Vibration Isolation and Damping.
	CO2	Identify suitable Vibration Absorber
	CO3	Identify suitable Vibration Isolator
	CO4	Apply suitable method to Control the vibrations to the acceptable level.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction:** Vibration reduction at source, factors affecting vibration level, isolation of the source, methods of vibration control, dynamic properties and selection of materials	3,4, Links	5
2	2.1	**Dynamic vibration absorbers:** Dynamic vibration neutralizers, self-tuned pendulum neutralizer, optimum design of damped absorbers, absorber with ideal spring and viscous dashpot, gyroscopic vibration absorbers, impact absorbers, absorbers attached to continuous systems	3,4, Links	8
3	3.1	**Vibration isolation of single degree of freedom systems:** Isolators with complex stiffness, Isolators with Coulomb damping, Three-element isolators, Two-stage isolators, Pneumatic suspension, Concept of negative stiffness in vibration isolation	3,4, Links	8
4	4.1	**Active vibration control:** Classification and modelling, actuators and sensors for active vibration control, Active vibration absorption and damping, classical control, optimal control, Piezoelectric transducers for active vibration control	1,2	8
	4.2	**Semi-active vibration control:** Introduction, Magneto-rheological fluids, MR models and devices, semi-active suspension, narrowband disturbance	1,2	
5	5.1	**Active, semi-active, and adaptive dynamic vibration absorbers:**	1,2	5

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		Active tuned vibration absorber, active mass damper, adaptive vibration absorber, semi-active tuned vibration absorber		
6	6.1	**Active and semi-active vibration isolation:** Active single-axis base isolation, active force isolation system, isolator based on piezoelectric stack actuator, semi-active isolation, Adaptive-passive vibration isolation, active control of vehicle suspensions	1,2	5
Total				**39**

Recommended Books:

1. A.K. Mallik and A. Chatterjee, "Principles of Active and Passive Vibration Control", East-West-Press 2014, ISBN: 9788176710985

2. A. Preumont, "Vibration Control of Active Structures", Springer 2018, ISBN: 9783319722962

3. S.S. Rao, "Mechanical Vibrations", 5th Edition 2004, Pearson Publications

4. Clarence de Silva, "Vibration: Fundamentals and Practice",1st Edition 2000, CRC Press, ISBN: 0849318084

Links for online NPTEL/SWAYAM courses:

https://nptel.ac.in/courses/112104211 – Principles of Vibration Control, IIT Kanpur
https://nptel.ac.in/courses/112107088 – Vibration control, IIT Roorkee

Course Assessment:

Theory:

      ISE-1: Quiz and Assignments based on 50% syllabus (20 marks)

      ISE-2: Quiz and Assignments based on remaining 50% syllabus (20 marks)

      MSE: Two hours 30 Marks written examination based on 50% syllabus

      ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
MEDLO7043	Advanced Vibration	3	--	--		3	--	--	3
		Examination Scheme							
		ISE1	MSE	ISE2	ESE			Total	
		20	30	20	100 (30% weightage)			100	

Pre-requisite Course Codes		Vibration Controls
Course Outcomes	CO1	Estimate natural frequency of mechanical element / system.
	CO2	Understand the concepts of Vibration Isolation and Control.
	CO3	Analyse vibratory response of mechanical element / system.
	CO4	Analyse vibration of Continuous system.
	CO5	Analyse Random Vibrations.
	CO6	Analyse Non-Linear Vibrations.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Multi Degree of Freedom System:**		6
	1.1	**Undamped free vibration:** Free vibration equation of motion, Influence coefficients (stiffness and flexibility), Reciprocity theorem, Generalized Coordinates, and Coordinate Coupling, Lagrangian equations, Rayleigh and Dunkerley method, two rotor and geared systems	1,2, Link1	
	1.2	**Eigen Values and Eigen vectors:** for translatory and torsional two d.o.f. systems, Matrix method, Holzer's method (translatory and torsional unbranched systems)	1,2, Link1	
2	2.1	**Vibration Isolation and Control:** Introduction, Vibration isolation theory, Vibration isolation and motion isolation for harmonic excitation, practical aspects of vibration analysis, vibration isolation, Dynamic vibration absorbers, and Vibration dampers, Passive, semi-active, and active vibration control	2,3	6
3	3.1	**Vibration Measurement:** Introduction, Transducers, Vibration pickups, Frequency measuring instruments, Vibration exciters, Signal analysis.	2,3	6
	3.2	**Modal analysis and Condition Monitoring:** Dynamic Testing of machines and Structures, Experimental Modal analysis, Machine condition monitoring and diagnosis.	2,3	
4	4.1	Vibration of Continuous Systems: Vibration of string, Longitudinal vibration of rods, Torsional vibration of rods, Euler equation for beams.	2,5	7
5	5.1	**Random Vibrations:** Random phenomena, Time averaging and expected value, Frequency response function, Probability	2,5	7

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		distribution, Correlation, Power spectrum and power spectral density, Fourier transforms and response.		
6	6.1	**Non-Linear Vibrations:** Introduction, Sources of nonlinearity, Phase plane, Conservative systems, Stability of equilibrium, Method of isoclines, Perturbation method, Method of iteration, Self-excited oscillations, Runge-Kutta method.	2, Link3	7
Total				**39**

Recommended Books:

1. W.T. Thomson and M.D. Dahleh, "Theory of Vibration with Applications", 3rd Edition 2002, Pearson Education

2. G.K. Grover, "Mechanical Vibraitons", 5th Edition 2009, Nem Chand and Bros, ISBN: 978-8185240565

3. W.W. Seto, "Mechanical Vibrations- Schaum's Outline Series", McGraw Hill, ISBN: 9780070563278

4. S.S. Rao, "Mechanical Vibrations", 5th Edition 2004, Pearson Publications

5. Leonard Meirovitch, "Fundamentals of Vibration", 1st Edition 2010, McGraw Hill, ISBN: 978-1577666912.

Links for online NPTEL/SWAYAM courses:

https://nptel.ac.in/courses/112107212 – Introduction to Mechanical Vibration, IIT Roorkee
https://nptel.ac.in/courses/112103111 – Mechanical Vibrations, IIT Guwahati
https://nptel.ac.in/courses/112103022 – Nonlinear Vibration, IIT Guwahati
https://nptel.ac.in/courses/112104211 – Principles of Vibration Control, IIT Kanpur**Course**

Assessment:

Theory:

  ISE-1: Quiz and Assignments based on 50% syllabus (20 marks)

  ISE-2: Quiz and Assignments based on remaining 50% syllabus (20 marks)

  MSE: Two hours 30 Marks written examination based on 50% syllabus

  ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Fr. Conceicao Rodrigues College of Engineering

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		03	--	--	03	--	--	03
ILO7011	**Product Life Cycle Management**	**Examination Scheme**						
		Theory	ISE1	MSE	ISE2	ESE	Total	
			20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	--	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
	CO2	Illustrate various approaches and techniques for designing and developing products.
	CO3	Apply Product Engineering Guidelines/ thumb rules in designing products for molding, machining, sheet metal working etc.
	CO4	Acquire knowledge in applying virtual product development tools for components,machining and manufacturing plant

Module No.	Unit No.	Topics	Ref.	Hrs.
1. Introduction to Product Lifecycle Management (PLM):	1.1	Product Lifecycle Management(PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM	[1], [2]	10
2. Product Design	2.1	Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post Design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	[2]	9

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

3 **Product Data Management (PDM):**	**3.1**	Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	[1], [2]	5
4. **Virtual Product Development Tools**	**4.1**	For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital Mock-up, Model Building, Model analysis, Modeling and simulations in Product Design, Examples/ Case studies	[1]	5
5. **Integration of Environmental Aspects in Product Design**	**5.1**	Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	[1], [2]	5
6 **Life Cycle Assessment and Life Cycle Cost Analysis:**	**6.1**	Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution Models for Product Life Cycle Cost Analysis	[3]	5
			Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus

ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:
1. John Stark,"Product Life cycle Management: Paradigm for 21st Century Product Realization", Springer- Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice,Guido La Rosa,Antonino Risitano,"Product Design For The Environment-A Lifecycle approach", Taylor & Francis 2006, ISBN:0849327229
3. Antti, Immonen Anselmi,"Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve,"Product Life cycle Management: Driving the next generation of lean thinking", Tata Mc Graw Hill, 2006 , ISBN: 0070636265

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
ILO7012	**Reliability Engineering**	L	T	P	L	T	P	Total
		03	--	--	03	--	--	03
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	Engineering Mathematics	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Understand and apply the concept of Probability to engineering problems
	CO2	Apply various reliability concepts to calculate different reliability parameters
	CO3	Estimate the system reliability of simple and complex systems
	CO4	Carry out a Failure Mode Effect and Criticality Analysis

Module No.	Unit No.	Topics	Ref.	Hrs.
1.	1.1	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem.	[1], [2]	8
	1.2	**ProbabilityDistributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance.	[2]	
	1.3	**Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation,Variance, Skewness and Kurtosis	[1]	
2.	2.1	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, BathTub Curve.	[1]	8
	2.2	**Failure Data Analysis:** Hazardrate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions.	[1], [2]	
	2.3	**Reliability Hazard Models:** Constant Failure Rate, Linearly Increasing, Time Dependent Failure Rate, Weibull Model. Distribution Functions And Reliability Analysis.	[2]	
3	3.1	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	[1]	5
4.	4.1	**Reliability Improvement:** RedundancyTechniques: Element Redundancy, Unit Redundancy, And Standby Redundancies.Markov Analysis. System Reliability Analysis– Enumeration method, Cut-set method, Success Path method, Decomposition method.	[2], [3]	8
5.	5.1	**Maintainability and Availability** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and	[1], [2]	5

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability–qualitative aspects.		
6	6.1	**Failure Mode, Effects and Criticality Analysis: Failure Mode Effects Analysis, severity**/ criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis	[3]	5
			Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus
ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:

1. L.S.Srinath, "Reliability Engineering", Affiliated East-West Press (P) Ltd., 1985.
2. Charles E.Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S.Dhillon, C.Singh,"Engineering Reliability", John Wiley & Sons,1980.
4. P.D.T.Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson,"Reliability in Engineering Design", John Wiley& Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata Mc Graw-Hill Publishing Co. Ltd.

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		03	--	--	03	--	--	03
ILO7013	**Management Information System**	Examination Scheme						
		Theory	ISE1	MSE	ISE2	ESE	Total	
			20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	Data Warehouse and mining	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Explain how information systems Transform Business
	CO2	Identify the impact information systems have on an organization
	CO3	Describe IT infrastructure and its components and its current trends
	CO4	Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
	CO5	Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module No.	Unit No.	Topics	Ref.	Hrs.
1.	**1.1**	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, and Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	[1]	4
2.	**2.1**	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business Intelligence(BI): Managers and Decision Making, BI for Data analysis and Presenting Results	[1], [2]	7
3	**3.1**	Ethical issues and Privacy: Information Security.Threat to IS, and Security Controls	[1]	7
4.	**4.1**	SocialComputing (SC): Web2.0 and 3.0, SCan business-shopping, Marketing, Operational and Analytical CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	[2]	7
5.	**5.1**	Computer Networks Wired and Wireless Technology, Pervasive Computing, Cloud computing model.	[3]	6
6	**6.1**	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support Business Process, Acquiring Information Systems and Applications: Various System development lifecycle models.	[1]	8
			Total	**39**

Society of St. Francis Xavier, Pilar's

Fr. Conceicao Rodrigues College of Engineering

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus

ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:

1. Kelly Rainer, Brad Prince, Management Information Systems,Wiley
2. K.C. Laudon and J.P.Laudon, Management Information Systems: Managing The Digital Firm, 10thEd. Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, PrenticeHall, 2008

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		03	--	--	03	--	--	03
ILO7014	**Design of Experiments**	**Examination Scheme**						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	--	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Plan data collection, to turn data into information and to make decisions that lead to appropriate action
	CO2	Apply the methods taught to real life situations
	CO3	Plan, analyze, and interpret the results of experiments

Module No.	Unit No.	Topics	Ref.	Hrs.
1. Introduction	**1.1**	Strategy of Experimentation	[1]	6
	1.2	Typical Applications of Experimental Design	[1]	
	1.3	Guidelines for Designing Experiments	[1]	
	1.4	Response Surface Methodology	[1]	
2. Fitting Regression Models	**2.1**	Linear Regression Models	[1],[2]	8
	2.2	Estimation of the Parameters in Linear Regression Models	[1],[2]	
	2.3	Hypothesis Testing in Multiple Regression	[1],[2]	
	2.4	Confidence Intervals in Multiple Regression	[1],[2]	
	2.5	Prediction of new response observation	[1],[2]	
	2.6	Regression model diagnostics	[1],[2]	
	2.7	Testing for lack off it	[1],[2]	
3 Two-Level Factorial Designs and Analysis	**3.1**	The 2^2 Design	[3]	7
	3.2	The 2^3 Design	[3],[4]	
	3.3	The General 2^k Design	[4]	
	3.4	A Single Replicate of the 2^k Design	[1],[2]	
	3.5	The Addition of Center Points to the 2^k Design,	[2]	
	3.6	Blocking in the 2^k Factorial Design	[1]	
	3.7	Split-Plot Designs	[1],[2]	
4. Two-Level Fractional Factorial Design	**4.1**	The One-Half Fraction of the 2^k Design	[3]	7
	4.2	The One-Quarter Fraction of the 2^k Design	[2]	
	4.3	The General 2k-p Fractional Factorial Design	[1],[2]	
	4.4	Resolution III Designs	[2]	

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Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

And Analysis	**4.5**	Resolution IV and V Designs	[2]	
	4.6	Fractional Factorial Split-Plot Designs	[3]	
5. **Conducting** **Tests**	**5.1**	Testing Logistics	[1],[2]	
	5.2	Statistical aspects of conducting tests	[1]	
	5.3	Characteristics of good and bad datasets	[1],[2]	7
	5.4	Example experiments	[1],[2]	
	5.5	Attribute Vs Variable datasets	[2]	
6 **Taguchi** **Approach**	**6.1**	Crossed Array Designs and Signal-to-Noise Ratios	[6]	
	6.2	Analysis Methods	[6]	4
	6.3	Robust design examples	[6]	
			Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus

ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley& Sons, New York, 2001
2. D.C.Montgomery, Design And Analysis Of Experiments,5th edition, John Wiley & Sons, New York, 2001
3. George EPBox, JStuart Hunter, William G Hunter, Statistics for Experimenters: Design, Innovation And Discovery, 2ndEd. Wiley
4. WJ Diamond, Practical Experiment Designs for Engineers and Scientists, John Willy and SonsInc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer texts in Statistics), Springer by A.M. Dean, and D. T. Voss
6. Phillip J Ross,"Taguchi Techniques for Quality Engineering,"McGraw Hill
7. Madhav Phadke,"Quality Engineering using Robust Design,"Prentice Hall

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		03	--	--	03	--	--	03
ILO7015	**Operations Research**	**Examination Scheme**						
		Theory	**ISE1**	**MSE**	**ISE2**	**ESE**	**Total**	
		Theory	20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	Engineering Mathematics	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
	CO2	Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
	CO3	Solve specialized linear programming problems like the transportation and assignment problems; solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
	CO4	Understand the applications of integer programming and queuing model and compute important performance measures

Module No.	Unit No.	Topics	Ref.	Hrs.
1. Introduction to Operations Research	**1.1**	**Introduction to Operations Research**: Introduction, Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method,Simplex Method Penalty Cost Method or BigM-method, Two Phase Method, Revised Simplex Method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complementary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's Approximation Method. Optimality Test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing Jobs Through Two Machines And Machines, Graphical Method of Two Jobsm Machines Problem Routing	[1]	14

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		Problem, Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's Cutting Plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.		
2. **Queuing models**	**2.1**	**Queuing Models**: queuing systems structures, single server multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	[1], [2]	5
3 **Simulation**:	**3.1**	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Application of Simulation, Advantages of Simulation, Limitations of Simulation	[1]	5
4. **Dynamic programming**	**4.1**	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management Employment Smoothening, capital budgeting, Stagecoach/ Shortest Path, cargo loading and Reliability problems	[2]	5
5. **Game Theory**	**5.1**	**GameTheory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2X2 games	[1], [2]	5
6 **Inventory Models**	**6.1**	**Inventory Models**: Classical EOQModels, EOQModel with Price Breaks, EOQwith Shortage, Probabilistic EOQ Model,	[2]	5
			Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus
ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:
1. Taha, H. A. "Operations Research- An Introduction",Prentice Hall, (7thEdition),2002.
2. Ravindran, A, Phillips, D. Tand Solberg,J.J."Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F.S.and Liebermann,G.J."Introduction to Operations Research", Tata Mcgraw Hill, 2002.
4. Operations Research, S. D.Sharma, Kedar Nath Ram Nath- Meerut.
5. Operations Research, Kanti Swarup, P.K. Gupta and Man Mohan, Sultan Chand & Sons.

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		03	--	--	03	--	--	03
ILO7016	**Cyber Security and Laws**	**Examination Scheme**						
		Theory	ISE1	MSE	ISE2	ESE	Total	
			20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	Computer Networks and cyber security	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Understand the concept of cyber crime and its effect on outside world
	CO2	Interpret and apply IT law in various legal issues
	CO3	Distinguish different aspects of cyber law
	CO4	Apply Information Security Standards compliance during software design and development

Module No.	Unit No.	Topics	Ref.	Hrs.
1. **Introduction to Cyber crime**	**1.1**	Cyber crime definition and origins of the world, Cybercrime And Information security, Classifications Of Cyber Crime,Cybercrime And The Indian ITA2000, A Global Perspective On Cyber Crimes.	[1]	4
2. **Cyber offenses & Cybercrime**	**2.1**	How criminal plan the attacks, Social Engg, Cyberstalking, Cybercafé and Cybercrimes, Botnets, Attackvector, Cloud Computing, Proliferation of Mobile and Wireless Devices,Trends In Mobility, Credit Card Frauds Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/CellPhones, Mobile Devices:Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues,Organizational Security Policy and Measure in Mobile Computing Era, Laptops	[1], [2]	9
3 **Tools and Methods Used in Cyberline**	**3.1**	Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQLInjection, Buffer OverFlow, Attacks onWireless Networks, Phishing, Identity Theft (IDTheft)	[1], [2]	6
4. **The Concept of Cyberspace**	**4.1**	E-Commerce, The Contract Aspects In Cyber Law, The Security Aspect of Cyber Law , The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law ,The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking, The Need for an Indian Cyber Law	[3]	8

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

5. **Indian IT Act.**	**5.1**	Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, ITS Act. 2008 and its Amendments	[1], [2]	6
6 **Information** **Security** **Standard** **compliances**	**6.1**	SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	[1]	6
				Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus

ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:

1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan ; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, Information Systems Security, Wiley India, New Delhi
6. Kennetch J. Knapp, Cyber Security & Global Information Assurance Information Science Publishing.
7. William Stallings,Cryptography And Network Security, Pearson Publication

Website References
1. The Information Technology ACT 2008-TIFR : https://www.tifrh.res.in
2. Website For More Information , A Compliance Primer for IT professional
3. https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		03	--	--	03	--	--	03
ILO7017	**Disaster Management and Mitigation measures**	**Examination Scheme**						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	--	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Get to know natural as well as man made disasters and their extent and possible effects on the economy.
	CO2	Plan of national importance structures based upon the previous history.
	CO3	Get acquainted with government policies, acts and various organizational structures associated with an emergency.
	CO4	Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module No.	Unit No.	Topics	Ref.	Hrs.
1. Introduction	**1.1**	Definition of Disaster, hazard, global and Indianscenario, and general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	[1], [2]	3
2. Natural Disaster and Man made disasters:	**2.1**	Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion	[2]	9
	2.2	Man Made Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of man made disasters.	[1], [2]	
3 Disaster Management, Policy and Administration	**3.1**	Disaster Management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm Shift in disaster management.	[1]	6
	3.2	Policy and administration: Importance and principles of disaster management policies, command and co-ordination of disaster management, rescue operations-how to start with and how to proceed in due course of time, study of low charts showing the entire process.	[1], [2]	

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

4. **Institutional Framework for Disaster Management in India:**	**4.1**	Importance Of Public Awareness, Preparation and Execution Of Emergency Management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National Disaster Management Authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up facilities, importance of effective communication amongst different agencies in such situations.	[3]	6
	4.2	Use of Internet and software for effective disaster management. Applications of GIS, Remote sensing and GPSin this regard.	[2]	
5. **Financing Relief Measures:**	**5.1**	Ways To Raise Finance For Relief Expenditure, role of government agencies and NGOs in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGOs and the works they have carried out in the past on the occurrence of various disasters, Ways To Approach these teams.	[5], [6]	9
	5.2	International relief aid agencies and their role in extreme events.		
6 **Preventive and Mitigation Measures:**	**6.1**	Pre-disaster, during disaster and post-disaster measures in some events in general	[1], [2]	6
	6.2	Structural mapping: Risk Mapping, assessment analysis, seawalls and embankments, Bioshield, shelters, early warning and communication	[2]	
	6.3	Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans.	[1], [3]	
	6.4	Do's and don'ts in case of disasters and effective implementation of relief aids.	[3]	
			Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus
ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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Recommended Books:

1. 'Disaster Management' by HarshK.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India by. S.Dagur, publishedby Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by By Damon Coppola, Butterworth Heinemann Elsevier Publications.
4. Disaster Management Handbook biJak Pinkowski, CRCPress Taylor and Francis Group.
5. Disaster Management & rehabilitation Rajdeep Dasgupta, Mittal Publications, NewDelhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation–RBSingh, Rawat Publications
7. Concepts and Techniques of GIS–C.P.Lo Albert, K.W.Yonng–PrenticeHall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic websites)

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		03	--	--	03	--	--	03
ILO 7018	**Energy Audit and Management**	Examination Scheme						
		Theory	ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	--	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	To identify and describe the present state of energy security and its importance.
	CO2	To identify and describe the basic principles and methodologies adopted in energy audit of a utility.
	CO3	To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
	CO4	To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
	CO5	To analyze the data collected during performance evaluation and recommend energy saving measures

Module No.	Unit No.	Topics	Ref.	Hrs.
1. **Energy Scenario**	**1.1**	Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	[1]	4
2. **Energy Audit Principles**	**2.1**	Definition, Energy audit-need, Types of energy audit , Energy management (audit) approach- understanding energy costs, Benchmarking, Energy performance, Matching energy use to requirement, Maximizing System Efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring & targeting; Energy audit Instruments; Data And Information-analysis. Financial Analysis Techniques: Simple Payback Period, NPV, Return on investment (ROI), Internal rate of return (IRR)	[2]	8
3 **Energy Management and Energy Conservation in**	**3.1**	Electricity Billing, Electrical load management and maximum demand Control Power Factor Improvement, Energy efficient equipment and appliances ,star ratings. Energy Efficiency Measures In Lighting System, Lighting Control: Occupancy sensors, daylight integration, and use of intelligent controllers.	[1], [2]	10

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Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Electrical System		Energy Conservation Opportunities In: water pumps, industrial drives, induction motors, motor retrofitting,soft starters, variable speed drives.		
4. Energy Management and Energy Conservation in Thermal Systems	**4.1**	Review Of Different Thermal Loads; Energy Conservation Opportunities In: Steam Distribution System, Assessment Of Steam Distribution Losses, Steam leakages, Steam Trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	[3]	10
5. Energy Performance Assessment	**5.1**	On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	[1], [2]	4
6 Energy conservation in Buildings	**6.1**	Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application Of Non-Conventional and Renewable Energy Sources	[6]	3
			Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]
ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks
MSE: Two hours 30 Marks written examination based on initial 50% syllabus
ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:
1. Handbook of Electrical Installation Practice,Geofry Stokes, Blackwell Science
2. Designing With Light: Lighting Handbook, ByAnil Valia,LightingSystem
3. Energy Management Handbook, By W.C. Turner, John Wileyand Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi,
5. Tata Energy Research Institute (TERI).
6. Energy Management Principles,C.B.Smith,Pergamon Press
7. Energy Conservation Guidebook, Dale R.Patrick,S.Fardo, Ray E.Richardson, Fairmont Press
8. Handbook of Energy Audits, Albert Thumann, W.J. Younger,T. Niehus, CRCPress
Website References
1. www.energymanagertraining.com
2. www.bee-india.nic.in

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
		3	--	--		3	--	--	3
ILO7019	Development Engineering	Examination Scheme							
		ISE1	MSE	ISE2		ESE			Total
		20	30	20		100 (30% weightage)			100

Pre-requisite Course Codes		
	At the End of the course students will be able to :	
	CO1	Apply knowledge for Rural Development.
	CO2	Apply knowledge for Management Issues.
	CO3	Apply knowledge for Initiatives and Strategies
Course Outcomes	CO4	Develop acumen for higher education and research.
	C05	Master the art of working in group of different nature.
	CO6	Develop confidence to take up rural project activities independently.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services	[1], [2]	8
2	2.1	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development	[1], [2]	4
3	3.1	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local	[1], [2]	6

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		planning; Need for decentralized planning; Sustainable rural development.		
4	4.1	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	[1], [2]	4
5	5.1	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	[1], [2]	10
6	6.1	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	[1], [2]	4
				36

Course Assessment:
Theory:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus
ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:
1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory andPractice, Vol. 4, No.4, pp.395 – 407

Society of St. Francis Xavier, Pilar's

Fr. Conceicao Rodrigues College of Engineering

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
MEL701	Design of Mechanical Systems	--	--	2		--	--	1	1
		Examination Scheme							
		ISE1	MSE	ISE2		ESE		Total	
		20	--	30		--		50	

Pre-requisite Course Codes	Engineering Mechanics, Strength of Materials, Machine Design	
Course Outcomes	CO1	Apply the concept of system design.
	CO2	Design of Gear box.
	CO3	Design of hoisting mechanism of EOT crane,
	CO4	Design belt conveyor systems
	CO5	Design engine components such as cylinder, piston, connecting rod and crankshaft
	CO6	Design pumps for the given applications

Sr. No.	Topics
A)	
1	**DESIGN AND DETAILED ASSEMBLY DRAWING :** a) Computer aided Design and detailed assembly drawing (A3 size sheets) of any one design problem, from any CAD software i) Design of hoisting mechanisms ii) Design of belt conveyors iii) Design of Engine b) Design and detailed assembly drawing (Full Imperial drawing sheet 762x559 mm) of any one design problem from the following: i) Design of Gear box ii) Design of pumps
2	**COURSE PROJECT:** Students in a group of two to four should be able to apply and integrate the knowledge gained during the course. Design and preparation of working drawings of any system having minimum 5 to 6 components is expected. Course project may be given as development of software program using python, VB, C++, EXCEL etc for mechanical systems
B)	**ASSIGNMENT:** Exercises on following topics in the form of design calculations with sketches and / or drawings. 1. Methodology & Morphology of design 2. Design of gearbox (As mentioned in theory) 3. Design of Hoisting mechanism 4. Design of Belt conveyor 5. Engine design (SI/CI engine) 6. Design of Pump

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Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Assessment:

Laboratory Work: (ISE)

ISE-1: 1 design exercise (10 marks) and 2 assignments (10 Marks)
Continuous pre-defined rubrics-based evaluation
ISE-2: 1 design exercise (10 marks), 2 assignments (10 marks) and Course project (10 marks)
Continuous pre-defined rubrics-based evaluation

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
MEL702	Maintenance Engineering Lab	--	--	2		--	--	1	1
		Examination Scheme							
		ISE1	MSE	ISE2		ESE		Total	
		20	--	30		--		50	

Pre-requisite Course Codes		
Course Outcomes	CO1	Identify different tools used for maintenance.
	CO2	Apply different maintenance strategies.
	CO3	Demonstrate the process of servicing a machine.
	CO4	Identify common faults in Machinery using Vibration Spectrum.
	CO5	Interpret the Vibration Signals for Monitoring and Prognosis.

Sr. No.	Topics
1.	Identifications of different Tools used for maintenance (Spanner, Plier, Screw Driver, Allen Keys, Puller etc.)
2.	Dismantling and assembly of any one mechanical system (Gearbox, pumps, Injector, Fuel Pump, Tailstock etc.) (One job in a group of 4-5 students)
3.	Case studies based on Maintenance strategies (Breakdown, preventive, predictive and proactive)
4.	Machinery Servicing (Greasing, Oiling, Cleaning etc.)
5.	Condition Monitoring and Machinery Fault Diagnosis – Unbalance
6.	Condition Monitoring and Machinery Fault Diagnosis – Misalignment
7.	Condition Monitoring and Machinery Fault Diagnosis – Bent Shaft
8.	Condition Monitoring and Machinery Fault Diagnosis – Mechanical Looseness
9.	Condition Monitoring and Machinery Fault Diagnosis – Bearing Defects
10.	Condition Monitoring and Machinery Fault Diagnosis – Defects in gears
11.	Condition Monitoring and Machinery Fault Diagnosis – Defects in pumps
12.	Condition Monitoring and Machinery Fault Diagnosis – Defects in fans
13.	Condition Monitoring and Machinery Fault Diagnosis – Defects in blowers

Note :
1. First four experiments are mandatory. At least four experiments to be performed from the remaining.
2. A visit of students to an automobile service station/any other machinery maintenance workshop shall be arranged as a part of the above exercises.

References:
1. A.R. Mohanty, "Machine Condition Monitoring: Principles and Practices", CRC Press
2. R.A. Collacott, "Mechanical Fault Diagnosis and Condition Monitoring", Chapman and Hall
NPTEL

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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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https://nptel.ac.in/courses/112105232 – Machinery Fault Diagnosis and Signal Processing, IIT Kharagpur

Course Assessment:

Laboratory Work: (ISE)
  ISE-1: 4 experiments (20 marks)
  Continuous pre-defined rubrics-based evaluation
  ISE-2: 4 experiments (20 marks) and Industrial visit report and presentation (10 marks)
  Continuous pre-defined rubrics-based evaluation

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
MEL703	Industrial Skills	--	--	2		--	--	1	1
		Examination Scheme							
		ISE1	MSE	ISE2	ESE			Total	
		25	--	25	--			50	

Pre-requisite Course Codes	
Course Outcomes	CO1 Skilfully prepare and edit documents and slides on MS Word and MS PowerPoint etc.
	CO2 Execute functions on MS Excel.
	CO3 Learn how to navigate tasks and execute functions in G-suite.
	CO4 Understand and practice metacognitive skillsof creativity and problem solving.
	CO5 Hone team building and leadership skills.

Module	List of Experiments and Activities
1	**Computer/IT skills**
1.1	Basics of Computers- Desktop/Laptop operations
1.2	**Microsoft Office** **MS Word**- Assignment to Create and use various commands in a Word document (Page setup, text formatting, templates, SmartArt, Title and Ribbon bar, Editing etc.) **MS Excel**- Assignment to Create and tabulate a spreadsheet (Excel- data analysis, charts, pivot tables, VBA, etc.) **MS- Power point**- Assignment to design and use a Presentation Software(MSPPT, Prezi, etc. – Presentation design, templates, custom slides, animation, graphs, charts, troubleshooting etc.) **MS Outlook** (Navigation, archiving, tasks distribution, filters, scheduling etc.) G-Suite (Gmail, G-Meet, Calendar, Sheets, Docs, Slides etc.) An introduction to the typesetting package LATEX.
2	**Aptitude and Logical Reasoning**
2.1	Aptitude – Aptitude training, types of questions, mock tests
2.2	Logical Reasoning – Verbal and Non-verbal reasoning, Types of questions, Mock tests
3	**Developing Metacognitive skills**
3.1	Task orientation and Goal setting (can be based on Final year Project):
3.2	Creativity and Problem-solving
4	**Collaborative Techniques:Team building skills**
4.1	Activities on Team building

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

4.2	Case studies on Leadership, Decision making and Team building
5	**GD-PI**
5.1	Group Discussion – Factual, Strategic, Abstract, Case study, Picture based
5.2	Personal Interview–Types of Interview Questions, Strategies, Sample answers, Mock Interviews

Assignments:

Assignments and activities should enable a steady progress in developing the aforementioned skills.A record of the conducted activities can be attached in journal as image printouts, and write up of case studies.

1. Application of MS Office skills (Individual)
☐ Create and edit Word documents
☐ Create and execute MS Excel functions
☐ Create and enhance MS PPT
2. Writing a simple document in LATEX editor and running the typesetter program to produce finished document
3. Aptitude and Logical reasoning tests/practice sheets
4. Team building skills: Activities/Tasks to be performed as a team of 3 or 4 students.
5. Group Discussions
Case studies on problem-solving to be done as a team activity.
Personal Interview questions log book

Recommended Books:

1. Meenakshi Raman, Prakash Singh. Business Communication, Oxford University Press, 2012
2. Claudyne Wilder. The Presentations Kit: 10 steps for Selling Your Ideas, John Wiley & Sons, 1994.
3. Lesikar, Flatley. Basic Business Communication: Skills for Empowering the Internet Generation, Tata McGraw Hill, 2008. 4. Flavell, J. H. Cognitive development: Past, present, and future. 1992. 5. Thorpe, Edgar and Showick Thorpe. Objective English, Pearson, 2013. (7thedition Amazon) 6. Thorpe, Edgar. Test of Reasoning: for All Competitive Examination. 7th edition., Amazon 7. Sinha, Nishit K., Reasoning, Pearson. 8. Aggarwal, R.S., A Modern Approach to Logical Reasoning, S. Chand.
9. Weblinks - https://cambridge-community.org.uk/professional-development/gswmeta/index.html
10. Various Quantitative aptitude books and websites list https://eduly.in/best-quantitative-aptitude-books/
https://prepinsta.com/learn-aptitude/
https://www.simplilearn.com/learn-ms-excel-free-training-course-skillup
NPTEL
Creativity https://nptel.ac.in/courses/109101017
Course Era
MS Excel https://www.coursera.org/projects/introduction-microsoft-excel
G-suite https://www.coursera.org/projects/collaborating-g-suite-apps
Problem solving https://www.coursera.org/learn/problem-solving
Udemy
G-suite https://www.udemy.com/course/learn-gsuite/

Course Assessment:

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Laboratory Work: (ISE)

ISE-1: Assignment 1 to 3 (10 marks) and Aptitude test (15 marks)

Continuous pre-defined rubrics-based evaluation

ISE-2: Assignment 4 and 5 (25 marks)

Continuous pre-defined rubrics-based evaluation

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	**T**	**P**		**L**	**T**	**P**	**Total**
		--	--	6#		--	--	3	3
MEP701	**Major Project 1**	**Examination Scheme**							
		ISE1	**MSE**	**ISE2**	**ESE**		**Total**		
		10	**--**	**20**	**20**		**50**		

\# indicates work load of Learner (Not Faculty)

Pre-requisite Course Codes	-	
	CO1	Students will be able to develop the understanding of the problem domain through extensive review of literature.
	CO2	Students will be able to identify and analyze the problem in detail to define its scope with problem specific data.
	CO3	Students will be able to identify various techniques to be implemented for the selected problem and related technical skills through feasibility analysis.
Course Outcomes	CO4	Students will be able to design solutions for real-time problems that will positively impact society and environment.
	CO5	Students will be able to develop clarity of presentation based on communication, teamwork and leadership skills.
	CO6	Students will be able to inculcate professional and ethical behavior.

Guidelines:
1. Project Topic Selection and Allocation:
- Project topic selection Process to be defined and followed:
  - Project orientation can be given at the end of sixth semester.
  - Students should be informed about the domain and domain experts whose guidance can be taken before selecting projects.
  - Student's should be recommended to refer papers from reputed conferences/ journals like IEEE, Elsevier, ACM etc. which are not more than 3 years old for review of literature.
  - Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements. Students can be informed to refer Digital India portal, SIH portal or any other hackathon portal for problem selection.
- Topics can be finalized with respect to following criterion:
  - Topic Selection: The topics selected should be novel in nature (Product based, Application based or Research based) or should work towards removing the lacuna in currently existing systems.
  - Technology Used: Use of latest technology or modern tools can be encouraged.
  - Students should not repeat work done previously (work done in the last three years).
- Project work must be carried out by the group of at least 2 students and maximum 4.

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

- The project work can be undertaken in a research institute or organization/Industry/any business establishment. (out-house projects)
- The project proposal presentations can be scheduled according to the domains and should be judged by faculty who are expert in the domain.
- Head of department and senior staff along with project coordinators will take decision regarding final selection of projects.
- Guide allocation should be done and students have to submit weekly progress report to the internal guide.
- Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.
- In case of industry/ out-house projects, visit by internal guide will be preferred and external members can be called during the presentation at various levels

2. Project Report Format:

At the end of semester, each group need to prepare a project report as per the guidelines issued by the University of Mumbai.

A project report should preferably contain at least following details:

- Abstract
- Introduction
- Literature Survey
    - Survey of Existing systems
    - Limitations of Existing systems or research gaps
    - Motivation (Challenges that are encouraging to choose the problem)
    - Problem Statement and Proposed Solution
    - Scope of the system
- Proposed System
    - General Workflow/Block diagram
- Analysis and Modeling (only applicable diagrams)
- Design
    - Architectural View
    - Algorithms/ Methodology
- Experimental Set up
    - Details of Database or details about input to systemsor selected data
    - Performance Evaluation Parameters (for Validation)
    - Software and Hardware Set up
- Implementation Plan for Next Semester
    - Timeline Chart for Term1 and Term-II (Project Management tools can be used.)
- Summary
- References

Desirable

Students can be asked to undergo some Certification course (for the technical skill set that will be useful and applicable for projects.)

Course Assessment:

ISE-1: Continuous Evaluation by project guide followed by presentation before a panel of examiners based on predefined rubrics (10 marks)

Society of St. Francis Xavier, Pilar's

Fr. Conceicao Rodrigues College of Engineering

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

ISE-2: Continuous Evaluation by project guide followed by presentation before a panel of examiners (20 marks)

ESE: Continuous Evaluation by project guide followed by presentation before a panel of examiners (20 marks)

Fr. Conceicao Rodrigues College of Engineering

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	**T**	**P**		**L**	**T**	**P**	**Total**
MEC801	Operations Planning and Control	**3**	**--**	**--**		**3**	**--**	**--**	**3**
		Examination Scheme							
		ISE1	**MSE**	**ISE2**		**ESE**			**Total**
		20	**30**	**20**		**100 (30% weightage)**			**100**

Pre-requisite Course Codes		-
Course Outcomes	CO1	Illustrate operations functions and manage operations in a better way.
	CO2	Apply various strategies to develop aggregate production plan based on the demand forecasting.
	CO3	Apply various algorithms in scheduling and sequencing of manufacturing and service operations
	CO4	Develop Material Requirements Plans (MRP) to estimate the planned order releases.
	CO5	Apply various techniques for facility layout planning and line balancing to optimize the resources
	CO6	Demonstrate the importance of implementation of JIT, Lean, Agile and Synchronous manufacturing in manufacturing and service organizations.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction:** Production and Operations Function, Production systems, Make to stock, Make to order, Assemble to order and Engineer to order, type of layouts, Phases in OPC like Preplanning, Planning, Action & Control.	3	6
	1.2	**Strategic Planning for Operations and Services:** Approaches like Forced Choice model and Operations Model, Quality and Productivity strategy, Technology strategy. Operations Strategies for Services, Types or Service Operations: Quasi manufacturing, Customer as participants, Customer as product, Classification of Services, Service capacity.	1	
2	2.1	**Forecasting:** Forecasting and Prediction, Need for forecasting, role of forecasting in OPC, Methods of forecasting, Qualitative methods, Quantitative methods like time series analysis, least square method, moving average method, and exponential smoothing method. Forecasting Error; Mean Absolute Deviation, Forecasting Bias	1	8
	2.2	**Capacity Planning:** Measurement of capacity, Measures of operating capacity, Factors influencing effective capacity, factors	3	

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		favouring over capacity and under capacity, short range, medium range and long range capacity planning. Capacity requirement Planning (CRP)		
	2.3	**Aggregate planning:** Concept of aggregate planning, Pure Strategy; Mixed Strategy; Level Strategy, Rough cut capacity planning, Aggregate planning for Services; Optimal Models for Aggregate Planning; Linear Programming; Linear Decision Rules Master Production Schedule	3	
3	3.1	**Job shop/Intermittent Manufacturing Scheduling:** Factors influencing scheduling, Inputs for scheduling, Forward Scheduling, Backward Scheduling, Stages in Scheduling: Product sequencing, Loading and Dispatching, dispatching, progress report & expediting and control. Basic scheduling problems, Priority Sequencing, Gantt Charts, Johnson's Rule for optimal sequence of N jobs on 2 machine. Process N Jobs on 3 Machines (N/3 problem) and Jackson Algorithm. Processing of 2 Jobs on M Machine (2/M) problem,	3	8
	3.2	**Project scheduling:** Network analysis - PERT & CPM, cost analysis & crashing, resource leveling and smoothening.	1	
4	4.1	**Material Requirement Planning:** Introduction, Limitations of conventional EOQ, Objectives of MRP, Inputs of MRP-I, Outputs of MRP, MRP lot sizing and Estimation of planned order releases, Manufacturing resource planning (MRP-II)	3	6
	4.2	**Enterprise Resource Planning (ERP):** Evolution, features, purpose of modeling an enterprise, ERP model for OPC, Modules in ERP, ERP Implementation Life Cycle, ERP packages like SAP-R3/Baan/PeopleSoft,	1	
5	5.1	**Facility layout planning:** Factors influencing Plant Layout, Material Flow Patterns, Tools and Techniques used for Plant Layout Planning.	3	6
	5.2	**Line Balancing:** Objectives, constraints, terminology in assembly line, heuristic methods like Kilbridge-Wester, Largest Candidate rule, Rank positional weight	1	
6	6.1	Introduction to JIT system, Lean, Agile and Synchronous manufacturing: Concept, Characteristics, Components and Implementation.	3	5
				39

Recommended Books:

1. "Production and Operations Management", K. Aswathappa & K. Shridhara Rao, Himalaya Publishing House, Revised 2nd Edition (2008)

2. "Industrial Engineering and Production Management", Martand Telsang, S. Chand, New Delhi (2009)

3. "Modern Production operations Management", Elwood S Buffa and Rakesh K Sarin, 8th Edition,Wiley Eastern, New York (1999) ISBN: 978-0471819059

4. "Production and Operations Management", Panneer Selvan R, 3rd Edition 2002Prentice Hall India, New Delhi, ISBN: 978-8120345553 5. "Production Planning and Control", Samuel Eilon, Universal Publication, ISBN: 9788185027548

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

6. "Production Planning and Control", L C Jhamb ,12th Edition 2010, Everest Pub House.

7. "Production Planning and Control", W. Boltan-Longman Scientific & Technical(1994), ISBN: 978-0582228207

8. "Production Systems- Planning, Analysis & Control", James. L. Riggs,John, 4th Edition 1987, Wiley & Sons, ISBN: 9780471847939

9. Manufacturing Planning and Control Systems, Thomas E. Vollman, William L. Berry & Others,4th Edition 1997, McGraw Hill Pub, ISBN: 978-0786312092

10. "Manufacturing Process Planning and Systems Engineering", Anand Bewoor, Dreamtech Press 2009, ISBN: 978-8177229967

11. "Production and Operations Management", S.N. Chary, 3rd Edition 2004, TMH publishing company, ISBN: 978-0070583559

12. Modernization & Material Management, L.C. Jhamb - Everest Publishing House

Course Assessment:
Theory:
       ISE-1: Assignments (20 marks)
       ISE-2: Article discussion and presentation on latest trends (20 marks)
       MSE: Two hours 30 Marks written examination based on 50% syllabus
       ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
		3	--	--		3	--	--	3
MEDLO8051	Composite Materials	Examination Scheme							
		ISE1	MSE	ISE2		ESE			Total
		20	30	20		100 (30% weightage)			100

Pre-requisite Course Codes		-	
Course Outcomes	CO1	Select the type of material for the fibres and matrix in a composite material for the given application.	
	CO2	Relate stresses and strains through the elastic constants for a given lamina.	
	CO3	Evaluate elastic properties of a lamina based on the properties of its constituents.	
	CO4	Predict failure of a lamina under the given loading condition.	
	CO5	Select the number of laminae and their stacking sequence in a composite material for the given loading condition.	
	CO6	Identify the type of damage occurring in a composite structure and select an appropriate method to repair it.	

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction** Classifications based on fibres and matrix, Advantages, Applications, Terminology, Manufacturing Methods: Hand layup, Spray layup, Vacuum bagging, Prepregs, Industrial autoclave, Filament winding, Pultrusion, Resin transfer moulding, Vacuum Infusion Processing, Powder metallurgy route for ceramic and metal matrix composites	1,2	8
2	2.1	Analysis of Lamina Hooke's law for different types of materials, Plane stress assumption, Hooke's law for a two-dimensional unidirectional lamina, Relationship of compliance and stiffness matrix to engineering elastic constants of a lamina, Hooke's law for a two-dimensional angle lamina, Engineering constants of an angle lamina	1,2	6
3	3.1	Lamina Failure Theories Introduction, Maximum stress failure theory, Maximum strain failure theory, Tsai- Hill failure theory, Tsai-Wu failure theory, Strength ratio, Failure envelopes	1,2	4
4	4.1	Introduction to Micromechanics of Lamina and Laminate Design	1,2	6

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		Prediction of mechanical properties of lamina based on properties of its constituents (fibre and matrix), Laminate types and their codes, Overview of laminate design (no problems on this topic)		
5	5.1	**Inspection of Composites** Different types of damages in composites, Non-destructive testing of composites: Ultrasonics inspection, Acoustography, Low frequency Methods, Radiographic inspection, Shearography, Acoustic emission, Thermography	3,4	6
6	6.1	**Repair of Composites** Restitution and repair of composites: Selection of Repair method, Repair criteria, Generic repair designs, Matrix cracks, Delamination, Holes and Fiber fracture, Damage removal and surface preparation	3,4	6
				36

Recommended Books:
Text Books:
1. M.Balasubramanian, "Composites materials processing" ,1st edition, CRC press 2013.
2. A.K. Kaw, "Mechanics of Composite Materials", Taylor and Francis Group, ISBN: 9780815351481
3. Ajay Kapadia, "Non Destructive Testing of Composite Materials", National Composites Network
4. R.B. Heslehurst, "Defects and Damage in Composite Materials and Structures", CRC Press 2014.

References:
1. R.M. Jones, "Mechanics of Composite Materials", 2nd Edition,Taylor and Francis, Inc,ISBN: 9781138571075
2. I.M. Daniel and O. Isai, "Engineering Mechanics of Composite Materials", 2nd Edition 2005,Oxford University Press, ISBN: 9780195150971
3. D. Gay, S.V. Hoe, and S.W. Tsai, "Composite Materials: Design and Applications", 3rd Edition 2014, CRC Press, ISBN: 978-1466584877
4. R.B. Heslehurst, "Defects and Damage in Composite Materials and Structures", CRC Press 2014.
5. M.M. Schwartz, "Composite Materials: Properties, Nondestructive Testing, and Repair", Prentice Hall PTR (1997), ISBN: 9780133000474

Course Assessment:
Theory:
        ISE-1: Quiz (20 marks)
        ISE-2: Presentation on recent topics on smart materials (20 marks)
        MSE: Two hours 30 Marks written examination based on 50% syllabus
        ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
		3	--	--		3	--	--	3
MEC8052	Smart Materials	Examination Scheme							
		ISE1	MSE	ISE2	ESE				Total
		20	30	20	100 (30% weightage)				100

Pre-requisite Course Codes		-	
Course Outcomes	CO1	Classify and select different types of smart materials	
	CO2	Comprehend Important Concepts and principles of Smart Materials	
	CO3	Synthesis, sensing and actuation of Piezoelectric Materials, Magneto strictive Materials, Shape Memory Alloys, Electroactive Polymers	
	CO4	Synthesis, sensing and actuation of Ferrofluids and Magneto rheological Fluids, Soft Matter, Carbon Nanotubes and Carbon nanostructures, Thermoelectric Materials	
	CO5	Classify and select Smart Materials for Energy Applications: Materials used for energy storage	
	CO6	Classify and select Composite Materials, Nano Composite Materials	

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Smart Materials:** Overview of the different types of Smart Materials, Smart materials used in structures, smart material for sensors, actuators controls, memory and energy storage and their inter-relationships, concept of High bandwidth- low strain generating materials (HBLS), and Low Bandwidth High Strain Generating Materials (LBHS), Nano Composite Materials	1,2,3,4	7
2	2.1	**Important Concepts of Smart Materials:** artificial skins, artificial muscles, biomimetic materials, materials with tuneable responses, non-linear properties, self-healing materials, adaptive structures, self-replicating materials/structures, self-assembly, inch worm devices, hysteresis, integrated sensing and actuation	1,2,3,4	8
3	3.1	**Overview of the following materials with focus on synthesis, constitutive/governing relationships, strengths and weaknesses, and applications (both sensing and actuation etc)** 1. Piezoelectric Materials	5,6,9	6

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		2. Magneto strictive Materials 3. Shape Memory Alloys 4. Electroactive Polymers		
4	4.1	**Overview of the following materials with focus on synthesis, strengths and weaknesses, and applications** 1. Ferrofluids and Magneto rheological Fluids and applications in dampers 2. Soft Matter and its applications as smart skins, smart textiles etc 3. Carbon Nanotubes and Carbon nanostructures and its applications 4. Thermoelectric Materials and Peltier devices	1,2,3,4	6
5	5.1	**Smart Materials for Energy Applications:** Materials used for energy storage, Hydrogen Storage Materials, Energy harvesting, Energy scavenging from vibrations	1,2,3,4	6
6	6.1	**Manufacturing techniques for smart materials:** micromanufacturing, high resolution lithography, LIGA process, Generative manufacturing processes such as STL, SLS, SPB, BPM, LOM, SGC, FDM, BIS, BPM, Self-assembly process, Ion beam processes,	1,2,3,4	6
				39

Recommended Books:

1. M.V. Gandhi and B.S. Thompson, "Smart Materials and Structures", Chapman & Hall, London; New York, 1992 (ISBN: 0412370107)

2. Mel Scwartz, "Encyclopedia of Smart Materials Vol. I and II", John Wiley & Sons

3. SenolUtku, "Theory of Adaptive Structures : Incorporating Intelligence into Engineered Products", CRC Press (1998), ISBN: 9780849374319

4. A.V. Srinivasan, "Smart Structures: Analysis and Design", Cambridge University Press,Cambridge; New York, 2001 (ISBN: 0521650267)

5. G. Gautschi, "Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers", Springer, Berlin; New York, 2002 (ISBN:3540422595)

7. K. Uchino, "Piezoelectric Actuators and Ultrasonic Motors", Kluwer Academic Publishers, Boston, 1997 (ISBN: 0792398114)

8. G. Engdahl, "Handbook of Giant Magneto strictive Materials", Academic Press, San Diego, Calif.; London, 2000 (ISBN: 012238640X)

9. K. Otsuka and C.M. Wayman, "Shape Memory Materials", Cambridge University Press, Cambridge; New York, 1998 (ISBN: 052144487X)

10. Eric Udd, "Fibre Optic Sensors: An Introduction for Engineers and Scientists", John Wiley & Sons, New York, 1991 (ISBN: 0471830070)

11. André Preumont, "Vibration Control of Active Structures: An Introduction", 2nd Edition, Kluwer Academic Publishers, Dordrecht; Boston, 2002 (ISBN: 1402004966)

12. HojjatAdeli, "Control, Optimization, and Smart Structures: High-Performance Bridges and Buildings of the Future", John Wiley, New York, 1999 (ISBN: 047135094X)

13. T.T. Soong, "Passive Energy Dissipation Systems in Structural Engineering", Wiley, Chichester; New York, 1997 (ISBN: 0471968218)

14. V.K. Wadhawan, Smart Structures: Blurring the Distinction Between the Living and Non-living , Oxford University Press, Oxford (2007) ISBN: 9780199229178

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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15. H.T. Banks, R.C. Smith and Y Wang, "Smart Structures: Modelling, Estimation and Control", Wiley, New York (1996)

16. Shape Memory Alloys, (ed) D.C. Lagoudas, Springer Science (2008)

17. S.K. Ghosh , "Self-healing Materials: Fundamentals, Design Strategies and Applications, Wiley-VCH Verlag GmbH and Co. (2009), ISBN: 978-3-527-31829-2

18. Kwang J KIm and Satoshi Tadokore, "Electroactive Polymers for Robotic Applications: Artificial Muscles and Sensors", Springer-Verlag, London (2007) ISBN: 9781846283710

19. S Priya and D J Inman, "Energy Harvesting Technologies", Springer-Verlag (2008) ISBN: 978-0-387-76463-4

20. MoriakiWakaki, "Optical Materials and Applications", CRC Press (2012) ISBN: 9781315221403

21. S.S. Ray and M Bousmina, "Polymer Nanocomposites and their Applications", American Scientific Publishers (2008)

Course Assessment:
Theory:

        ISE-1: Quiz (20 marks)

        ISE-2: Presentation on recent topics on smart materials (20 marks)

        MSE: Two hours 30 Marks written examination based on 50% syllabus

        ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
MEDLO8053	Micro Electro Mechanical Systems (MEMS)	3	--	--		3	--	--	3
		Examination Scheme							
		ISE1	MSE	ISE2		ESE			Total
		20	30	20		100 (30% weightage)			100

Pre-requisite Course Codes		
Course Outcomes	CO1	Apply laws of scaling for development of a MEMS device
	CO2	Understand the materials and their processing to make MEMS
	CO3	Select and use microfabrication techniques for microsystems
	CO4	Understand the development of micro sensors and actuators
	CO5	Analyze microsystems technology for technical feasibility as well as practicality
	CO6	Develop useful applications of MEMS.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Introduction to MEMS Unique characteristics of MEMS, Microsystems Technology- An Overview, typical MEMS and Microsystem Products, Scaling effects - scaling laws in miniaturization- Application of MEMS		5
2	2.1	**Material for MEMS and manufacturing** Structure of silicon and other materials - Silicon wafer processing - Bulk micromachining and Surface micromachining, Wafer-bonding. Thin-film deposition, Lithography, wet etching and dry etching.		7
3	3.1	**Micro-fabrication methods** LIGA and other moulding techniques- Soft lithography and polymer processing- Thick-film processing; Low temperature co-fired ceramic processing.		6
4	4.1	**MEMS components-micro sensors** Micro sensors - Basic principles and working of micro sensors- Acoustic wave micro sensors- Bio-medical micro sensors- Bio-sensors- Chemical microsensors – Optical Sensors – Pressure micro sensors- Thermal micro sensors-acceleration micro sensors		8
5	5.1	**Micro-actuators** Basic principles and working of micro actuators- Electrostatic micro actuators- Piezoelectric micro actuators- Thermal micro actuators- SMA micro actuators- Electromagnetic micro actuators, micro valves, micro pumps.		6

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

6	6.1	Case studies /research based on MEMS applications-impact of materials, processes and design, Actuation using Shape Memory Alloys, Medical device, micropumps		4
				38

Recommended Books:

Text books:
1. MEMS and Microsystems Design and Manufacture by Tai-Ran Hsu, Tata McGraw-Hill Publishing Company Ltd.
2. Foundation of MEMS by Chang Liu, Pearson Education

References:
1. Fundamentals of Microfabrication and Nanotechnology, by Marc J. Madou, CRC Press, 2011,ISBN: 9780849331800
2. Micromachined Transducers Sourcebook, by Gregory Kovacs, WCB McGraw-Hill, Boston, 1998, ISBN: 9780071164627
3. Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes, by M.H. Bao, Elsevier, New York, 2000, ISBN: 978-0444505583
4. Microsystem Design, by Stephen D Senturia, Springer Publication, 2000, ISBN: 9780792372462.
5. Micro sensors - Principles and Applications, by Julian W. Gardner, John Wiley & Sons, Inc.1994, ISBN: 9780471941361.

Course Assessment:
Theory:
> **ISE-1:** Quiz (20 marks)
> **ISE-2:** Article discussion and Presentations (20 marks)
> **MSE:** Two hours 30 Marks written examination based on 50% syllabus
> **ESE:** Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
MEDLO8061	Product Design and Development	3	--	--		3	--	--	3
		Examination Scheme							
		ISE1	MSE	ISE2		ESE			Total
		20	30	20		100 (30% weightage)			100

Pre-requisite Course Codes		-
Course Outcomes	CO1	Describe the process of product design & development.
	CO2	Employ engineering, scientific, and mathematical principles to develop and execute a design project from a concept to a finished product.
	CO3	Create 3D solid models of mechanical components using CAD software.
	CO4	Demonstrate individual skills using selected manufacturing techniques such as rapid prototyping.
	CO5	Fabricate an electromechanical assembly of a product from engineering drawings.
	CO6	Work collaboratively in a team to complete a design project.
	CO7	Effectively communicate the results of projects and other assignments both in a written and oral format.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Need for developing products, The importance of Engineering and Industrial design, The design process, Relevance of product lifecycle issues in design, Societal considerations in Engineering and Industrial Design, Generic product development process, Various phases of product development, Planning for products, Establishing markets - market segments - relevance of market research.	1-2	7
2	2.1	The design processes, Descriptive and prescriptive design models, Concept development & evaluation, Pugh's total design activity model, Concept generation and selection method, Embodiment design, Product architecture, and Steps in developing product architecture.	1-2	7
3	3.1	Identifying customer needs, Voice of Customer (VoC), Customer populations, Hierarchy of human needs, Need gathering methods, Establishing engineering characteristics, Competitive benchmarking, Quality Function Deployment (QFD), House of Quality (HoQ), Product design specification, Development of	1-2	7

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		product design with specifications using QFD, Relevant case studies.		
4	4.1	Creative thinking, Creativity and problem-solving methods, Creative thinking methods, Brainstorming technique, Gorden technique, Check listing technique, Synectic technique, Morphological Analysis, and Attribute Listing technique. Generating design concepts, Systematic methods of designing.	1-2	7
5	5.1	Industrial design, Basic forms & elements, Integrating basic forms & elements such as balance, rhythm, proportion, The golden rule of proportions, human factors, and design, User-friendly design, Design for serviceability, Design for environment.	1-2	7
6	6.1	Concept of Design for Manufacturing and Assembly (DFMA). Role of computers in product design and manufacturing process, Prototyping techniques such as Stereolithography (SLA), Selective laser sintering (SLS), Fused disposition Modelling (FDM), Laminated object manufacturing (LOM), 3-D printing, and Ballistic Particle Manufacturing (BPM).	1-2	7
				42

Recommended Books:
Text Books:
1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development," 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9.

2. Kevin Otto, Kristin Wood, "Product Design," Indian Reprint 2004, Pearson Education, ISBN 9788177588217.

Reference Books:
1. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction," 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7.

2. George E. Dieter, Linda C.Schmidt, "Engineering Design," 4th Edition, McGraw-Hill International Edition, 2009, ISBN 978-007-127189-9.

3. Yousef Haik, T. M. M. Shahin, "Engineering Design Process," 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141.

Course Assessment:
Theory:
    ISE-1: Quiz (20 marks)
    ISE-2: Case study presentation (20 marks)
    MSE: Two hours 30 Marks written examination based on 50% syllabus
    ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
		3	--	--		3	--	--	3
MEDLO8062	Design for X	Examination Scheme							
		ISE1	MSE	ISE2		ESE			Total
		20	30	20		100 (30% weightage)			100

Pre-requisite Course Codes		
Course Outcomes	CO1	Apply design concepts and guidelines for manufacturing and assembly.
	CO2	Demonstrate the concept of value analysis and its relevance.
	CO3	Understand the economics of product development
	CO4	Apply design concepts for reliability and maintainability

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**DESIGN FOR MANUFACTURE:** General design principles for manufacturability-strength and mechanical factors, mechanisms selection, evaluation method, Process capability- Feature tolerances-Geometric tolerances-Assembly limits—Datum features-Tolerance stacks		5
2	2.1	**DESIGN FOR ASSEMBLY:** Assembly processes-Handling and insertion process-Manual, automatic and robotic assembly-Cost of Assembly-Number of Parts-DFA guidelines		8
-3	3.1	VALUEENGINEERING: Introduction to Value Engineering and Value Analysis, Value types-functional—operational—aesthetic, Value engineering in product design; Advantages, Applications in product design, Problem identification and selection, Analysis of functions, Anatomy of function. Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies		8
4	4.1	**PRODUCT DEVELOPMENT ECONOMICS:** Elements of Economics Analysis-Quantitative and qualitative analysis-Economic Analysis Process-Estimating magnitude and time of future cash inflows and outflows-Sensitivity analysis-Project trade-offs-Trade-offs rules-Limitation of quantitative analysis-Influence of qualitative factors on project success		8
5	5.1	**CONCEPT OF RELIABILITY:**		5

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		Introduction: The study of Reliability and Maintainability, Concepts, Terms and Definitions, Applications, The Failure Distribution: The reliability Function, Mean Time to Failure, Hazard Rate Function, Bathtub Curve, Conditional Reliability		
6	6.1	**MAINTAINABILITY:** Analysis of down time, Report Time Distribution, Stochastic Point Processes, Reliability under Preventive Maintenance, State-Dependant System with Repair, Design for Maintainability.		5
				39

Recommended Books:

1. Harry Peck, Designing for Manufacture, Pitman Publications,1983.
2. George E Dieter, Engineering Design, McGraw-Hill Int Editions,2000
3. S.S. Iyer, Value Engineering, New Age International, 2000
4. Charles E. Ebeling, An Introduction to Reliability and Maintainability Engineering, TMH2000.

Course Assessment:
Theory:
    ISE-1: Assignments (20 marks)
    Continuous pre-defined rubrics-based evaluation
    ISE-2: Case Study presentation (20 marks)
    MSE: Two hours 30 Marks written examination based on 50% syllabus
    ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
		3	--	--		3	--	--	3
MEDLO8063	Total Quality Management	Examination Scheme							
		ISE1	MSE	ISE2		ESE			Total
		20	30	20		100 (30% weightage)			100

Pre-requisite Course Codes		
Course Outcomes	CO1	To apply QM and principles of TQM in organizational development process.
	CO2	To apply the QC & QM tools in process improvement.
	CO3	To apply SQC techniques to improve process quality.
	CO4	To apply Six Sigma project in TQM Implementation
	CO5	To apply QMS and Certification for Quality Accreditation
	CO6	To apply the advanced tools for Quality Sustainability.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Quality Management :** Definitions of Quality, product quality and service quality; the evolution of quality; need for Quality Management, Quality statements and Policy, Customer orientation & satisfaction, Customer complaints, customer retention; Supplier partnership, Supplier rating & selection, CSI, Costs of Quality, Prevention , appraisal and failure aspects , Use of COQ for improving quality and performance, Designing for quality, Quality of design, Quality of conformance.		8
	1.2	Basic concepts of TQM, TQM framework, Contributions of Deming, Juran and Crosby, Juran Triology , PDCA Cycle, Barriers to TQM; TQM principles; Strategic Quality Planning; Quality councils; employee involvement, motivation; Empowerment; Team and Teamwork; recognition and reward, performance appraisal.		
2	2.1	**QC Tools :** Seven QC Tools: Check Sheet, Histogram, Pareto Chart, Fishbone Diagram, Run Charts, Scatter Diagram, Process Flow Chart.		6
	2.2	**Seven QM Tools:** Program Decision Process Chart, Tree Diagram, Affinity Diagram, Prioritization Matrix, etc. Bench Marking Types – Process, Product, Quality Improvement Tools: Why-Why Analysis, Root Cause Analysis, Poka Yoke (Mistake Proofing)		

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Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

3	3.1	**Statistical Quality Control: 100% Inspection versus Sampling Inspection, Reasons for SQC.** **Acceptance Sampling:** Concept of Producer Risk and Consumers Risk. Operating Characteristics Curve. Sampling Plan – Single Sampling Plan versus Double Sampling Plan. Design Sampling Plan on the basis of MIL, ASQ Standards.		6
	3.2	**Statistical Process Control:** Variations – Concept, Causes – Random & Assignable, Difference – Process in Control versus Process is Capable, Control Charts, X-Bar, R, P and C Charts, Process Capability (Cp) & Process Capability Index (Cpk), Sigma Limits. Applications of Control Charts in Mass Production, Process Production.		
4	4.1	**Continuous Improvement:** Quality Circles, Quality Function Development (QFD), Taguchi quality loss function, Parameter Design, Robust Design; TPM- concepts, 5S, Kaizen, FMEA-stages, Zero Defect.		8
	4.2	**TQM Implementation:** Manufacturing and Service sectors, Introduction to Six Sigma: Definition, Concept, Methodology. Six Sigma Approaches – Design for Six Sigma (DFSS) Approach & DMAIC Approach, Six Sigma Tools: Applications to manufacturing and service sector including IT, ITeS, and E Com.		
5	5.1	**Quality Management System & Certification:** **QMS:** Elements and documentation, Quality auditing, Necessity for Certification & Certification Process, Benefits of Certification. Certifying Bodies & Accreditation Agencies, ISO 9000-2015 (5th Edition), Introduction to TS16949: Technical Specifications, QS9000, ISO14000- concepts, requirements and benefits. Case studies of TQM implementation in manufacturing and service sectors including IT and Environmental management systems- ISO 14000 Series Standards, Integration of ISO 14000 with ISO 9000.		6
	5.2	**Quality Awards:** Malcom Baldrige National Quality Award and Rajiv Gandhi National Quality award.		
6	6.1	**Future Trends in TQM :** Strategic approach to leadership , Customer centric endeavors , Involvement & empowerment of all employees / stake holders , Decision making based on real time facts , Win-Win policy with suppliers , New paradigms of Green & sustainability , TQM beyond Manufacturing i.e. Healthcare, Education, Finance. Accountability through new tools and technologies, Quality Analytics.		6
				40

Recommended Books:

1. Besterfield D.H. et al.: Total quality Management, 3rd Edition, Pearson Education Asia, 2006.
2. Janakiraman B. and Gopal R.K.: Total Quality Management, Prentice Hall India, 2006.

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

3. Poornima M. Charantimath: Total Quality Management, 2nd Edition, Pearson Education Asia, 2006.

4. N. Logothetis: Managing for Total Quality, 6th Edition, Prentice Hall of India Pvt. Ltd. 2003.

5. Suganthi L. and Samuel A.: Total Quality Management, Prentice Hall India, 2006.

6. Evans J.R. and Lindsay W.M.: The Management and Control of Quality, 8th Edition, 1st Indian Edition, Cengage Learning, 2012.

Reference Books:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.

2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.

Course Assessment:

Theory:

> **ISE-1:** Assignments (20 marks)
> Continuous pre-defined rubrics-based evaluation
> **ISE-2:** Case Study presentation (20 marks)
> **MSE:** Two hours 30 Marks written examination based on 50% syllabus
> **ESE:** Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ILO8021	**Project Management**	03	--	--	03	--	--	03
		Examination Scheme						
		Theory	ISE1	MSE	ISE2	ESE	Total	
			20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	Data structure concepts, Discrete structures	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Apply selection criteria and select an appropriate project from different options.
	CO2	Write work break down structure for a project and develop a schedule based on it.
	CO3	Identify opportunities and threats to the project and decide an approach to deal with them strategically.
	CO4	Use Earned value technique and determine & predict status of the project.
	CO5	Capture lessons learned during project phases and document them for future reference

Module No.	Unit No.	Topics	Ref.	Hrs
1. Project Management Foundation:	1.1	Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	[1], [2], [4], [5]	5
2. Initiating Projects:	2.1	How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics	[1]	6
3. Project Planning and Scheduling	3.1	GANTT chart. Introduction to Project Management Information System (PMIS).	[1]	8

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

4. **Planning** **Projects**	4.1	Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	[1]	6
5.	5.1	Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings.	[1]	8
	5.2	Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit		
	5.3	Project procurement management, contracting and outsourcing		
6.	6.1	Introduction to project leadership, ethics in projects. Multicultural and virtual projects	[1]	6
	6.2	Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.		
			Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus
ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:
1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		03	--		03	--		03
ILO8022	**Finance Management**	**Examination Scheme**						
		Theory	ISE1	MSE	ISE2	ESE	Total	
			20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	--	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Understand Indian finance system and corporate finance
	CO2	Take investment, finance as well as dividend decisions

Module No.	Unit No.	Topics	Ref.	Hrs
1.	1.1	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System.	[1], [2,], [4], [5]	6
	1.2	**Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills	[1]	
		Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market	[1]	
		Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	[1]	
2.	2.1	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio.	[1]	6
	2.2	**Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting	[1]	
3.	3.1	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision.	[1]	9

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Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

	3.2	**Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis	[1]	
4.	4.1	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)	[1]	10
	4.2	**Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities	[1]	
5.	5.1	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance.	[1]	5
		Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure		
6.	6.1	Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches— Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	[1]	3
			Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus

ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Society of St. Francis Xavier, Pilar's
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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Recommended Books:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ILO8023	**Entrepreneurship Development and Management**	03	--	--	03	--	--	03
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	Computer Networks	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Understand the concept of business plan and ownerships
	CO2	Interpret key regulations and legal aspects of entrepreneurship in India
	CO3	Understand government policies for entrepreneurs

Module No.	Unit No.	Topics	Ref.	Hrs.
1.	1.1	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership	[1], [2,],[4] ,[5]	4
	1.2	Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	[1]	

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

2.	2.1	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur .	[1]	9
	2.2	Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations.	[1]	
3.	3.1	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises.	[1]	5
4.	4.1	Indian Environment for Entrepreneurship: key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organizations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc.,5	[1]	8
	4.2	Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	[1][2]	
5.	5.1	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	[1]	8
6.	6.1	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level		5

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		growth strategies, Options – harvesting or closing small business Critical Success factors of small business		
			Total	39

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz of 10 marks for a 1 hour duration

ISE-2:

Student seminars based on case study application in practical, real-life domains for 20 marks, 1 hour duration

MSE: Two hours 30 Marks written examination based on initial 50% syllabus

ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
ILO8024	**Human Resource Management**	L	T	P	L	T	P	Total
		03	--	--	03	--	--	03
		Examination Scheme						
		Theory	ISE 1	MS E	ISE2	ESE	Total	
			20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	--	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Understand the concepts, aspects, techniques and practices of the human resource management.
	CO2	Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
	CO3	Gain knowledge about the latest developments and trends in HRM.
	CO4	Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers

Module No.	Unit No.	Topics	Ref.	Hrs
1. Introduction to HR	1.1	Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions.	[1], [2], [4], [5]	5
	1.2	Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	[1]	
2. Organizational Behavior (OB)	2.1	Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues	[1]	7

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

	2.2	Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness Perception: Attitude and Value, Effect of perception on Individual Decision making, Attitude and Behavior.	[1]	
	2.3	Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor);	[1]	
	2.4	Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study	[1]	
3. Organizational Structure & Design	3.1	Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies	[1]	6
4. Human resource Planning	4.1	Recruitment and Selection process, Job enrichment, Empowerment- Job- Satisfaction, employee morale. Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. Training & Development: Identification of Training Needs, Training Methods	[1]	5
5. Emerging Trends in HR	5.1	Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment.	[1]	6
	5.2	Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity. With special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation	[1] [2]	
6. HR & MIS Strategic HRM	6.1	Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries.	[1]	10
	6.2	Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals	[1] [2]	

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

	6.3	Labor Laws & Industrial Relations: Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	[1]	
			Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus
ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:
1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Society of St. Francis Xavier, Pilar's

Fr. Conceicao Rodrigues College of Engineering

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ILO8025	**Professional Ethics and Corporate Social Responsibility (CSR)**	03	--	--	03	--	--	03
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	--	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Understand rights and duties of business
	CO2	Distinguish different aspects of corporate social responsibility
	CO3	Demonstrate professional ethics
	CO4	Understand legal aspects of corporate social responsibility

Module No.	Unit No.	Topics	Ref.	Hrs
1.	1.1	The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	[1], [2], [4], [5]	4
2.	2.1	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy	[1]	8
	2.2	**Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	[1]	
3.	3.1	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs	[1]	6
4.	4.1	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	[1]	5
5.	5.1	Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	[1]	8
6.	6.1	**Corporate Social Responsibility in Globalizing India:**	[1]	8

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013		
			Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus

ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by BidyutChakrabarty, Routledge, New Delhi

Fr. Conceicao Rodrigues College of Engineering

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		03	--	--	03	--		03
ILO8026	**Research Methodology**	**Examination Scheme**						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	--	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Prepare a preliminary research design for projects in their subject matter areas
	CO2	Accurately collect, analyze and report data
	CO3	Present complex data or situations clearly
	CO4	Review and analyze research findings

Module No.	Unit No.	Topics	Ref.	Hrs.
1. Introduction and Basic Research Concepts	1.1	Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology	[1], [2],[4],[5]	9
	1.2	Need of Research in Business and Social Sciences	[1]	
	1.3	Objectives of Research	[1]	
	1.4	**Issues** and Problems in Research	[1]	
	1.5	Characteristics of Research:Systematic, Valid, Verifiable, Empirical and Critical	[1]	
2. Types of Research	2.1	Basic Research	[1]	7
	2.2	Applied Research	[1]	
	2.3	Descriptive Research	[1]	
	2.4	Analytical Research	[1]	
	2.5	Empirical Research	[1]	
	2.6	Qualitative and Quantitative Approaches	[1]	
3. Research Design and Sample Design	3.1	Research Design – Meaning, Types and Significance		7
	3.2	Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	[1]	
4. Research	4.1	Meaning of Research Methodology	[1]	8

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Methodology	4.2	Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f.** Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data Preparation of Research Report		
5. **Formulating Research Problem**	5.1	Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	[1]	4
6. **Outcome of Research**	6.1	Preparation of the report on conclusion reached	[1]	
	6.2	Validity Testing & Ethical Issues	[1]	4
	6.3	Suggestions and Recommendation	[1]	
			Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus

ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Society of St. Francis Xavier, Pilar's
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(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		3	--	--	3	--	--	3
ILO8027	**IPR and Patenting**	**Examination Scheme**						
		Theory	ISE1	MSE	ISE2	ESE	Total	
			20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	--	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	understand Intellectual Property assets
	CO2	assist individuals and organizations in capacity building
	CO3	work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module No.	Unit No.	Topics	Ref.	Hrs.
1.	1.1	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc.	[1], [2],[4],[5]	5
	1.2	**Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	[1]	
2.	2.1	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) activein IPR enforcement	[1]	7
	2.2	**Indian Scenario of IPR:**Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	[1]	
3.		**Emerging Issues in IPR:**Challenges for IP in digital economy, e-commerce, human genome,biodiversity and traditional knowledge etc.	[1]	5

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors		
4. **Research Methodology**	4.1	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method	[1]	7
5. **Formulating Research Problem**	5.1	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	[1]	8
6. **Outcome of Research**	6.1	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publicationetc, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	[1]	7
			Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus
ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:
1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO

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(Autonomous College affiliated to University of Mumbai)

7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting,Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Society of St. Francis Xavier, Pilar's
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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ILO8028	**Digital Business Management**	03	--	--	03	--	--	03
		Examination Scheme						
		Theory	ISE1	MSE	ISE2	ESE	Total	
			20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	--	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Identify drivers of digital business
	CO2	Illustrate various approaches and techniques for E-business and management
	CO3	Prepare E-business plan

Module No.	Unit No.	Topics	Ref.	Hrs.
1. Introduction to Digital Business-	1.1	Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, Opportunities and Challenges in Digital Business,	[1], [2],[4], [5]	9
	1.2	**Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services)	[1]	
2. Overview of E-Commerce	2.1	**E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals	[1]	6
	2.2	Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	[1]	

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

3. **Digital Business Support services**		ERP as e –business backbone, knowledge Tope Apps, Information and referral system	[1]	6
		Application Development: Building Digital business Applications and Infrastructure		
4. **Managing E-Business**	4.1	Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	[1]	6
5. **E-Business Strategy**	5.1	E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	[1]	4
6. **Materializing e-business**	6.1	**From Idea to Realization-Business plan preparation** **Case Studies and presentations**	[1]	8
			Total	**39**

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus
ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:
1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014

Society of St. Francis Xavier, Pilar's

Fr. Conceicao Rodrigues College of Engineering

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective - DOI:10.1787/9789264221796-enOECD Publishing

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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		03	--	--	03	--	--	03
ILO8029	Environmental Management	Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100 (30% weightage)	100	

Pre-requisite Course Codes	--	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Understand the concept of environmental management
	CO2	Understand ecosystem and interdependence, food chain etc.
	CO3	Understand and interpret environment related legislations

Module No.	Unit No.	Topics	Ref.	Hrs.
1.	1.1	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	[1], [2], [4], [5]	10
2.	2.1	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man- made disasters, Atomic/Biomedical hazards, etc.	[1]	6
3.	3.1	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	[1]	5
4.	4.1	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	[1]	10
5.	5.1	Total Quality Environmental Management, ISO-14000, EMS certification	[1]	5
6.	6.1	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	[1]	3
			Total	**39**

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Assessment:

ISE-1:
Assignments for 10 marks
Multiple choice questions (MCQ) quiz for 10 marks [1 hour duration]

ISE-2:
Seminars based on Case study/Application in practical, real-life domain for 20 marks

MSE: Two hours 30 Marks written examination based on initial 50% syllabus
ESE: Three hours 100 Marks (30% weightage) written examination based on entire syllabus

Recommended Books:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management,T V Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

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Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
MEL801	Product Design and Development	--	--	2		--	--	1	1
		Examination Scheme							
		ISE1	MSE		ISE2		ESE		Total
		20	--		30		--		50

Pre-requisite Course Codes	-	
Course Outcomes	CO1	Identify the need for developing products
	CO2	Select suitable PD&D processes
	CO3	Apply the creativity & industrial design methods to design & develop the chosen product
	CO4	Work collaboratively in a team to complete a PD&D project.
	CO5	Effectively communicate the results of projects and other assignments both in a written and oral format.

Sr. No.	Topics
	Assignments: Total 3 to 4 assignments have to be given. Assignments III and IV are compulsory and shall be treated like mini-projects. Two more could be covered from the remaining as case studies.
I	I. Based on Module No. 1 and 2. 1. Select any one consumer product, such as a) a mobile b) a laptop c) a pencil sharpener d) a table and chair e) a stool f) a bicycle g) a pen h) a storage device of any household items i) a cupboard etc.…. anything Assume that you want to go for re-development of any one of the products. How would you tackle by answering any 3 or 4 points that are given below? Q1. How do you identify the need for developing the product? Q2. What are the changes that you would like to incorporate? Q3. Would it be Engineering Design or Industrial design factors or both? Q4. What are the generic PD&D processes that you would like to adopt? Q5. What are the methods that you would adopt for Market research? Q6. If you would like to develop which design process you would like to adopt? Q7. If you select descriptive design… then why? If you select prescriptive design… then why? Q8. What are the steps that you would like to adopt while developing the product?
II	II. Based on Module No. 3.

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

	2. Select any one consumer product, such as a) a mobile b) a laptop c) a pencil sharpener d) a table and chair e) a stool f) a bicycle g) a pen h) a storage device of any household items i) a cupboard etc..…. anything Assume that you want to go for re-development of any one of the above products. How would you tackle by answering any 3 or 4 points that are given below? Q1. How do you identify the customer needs for developing the product? Q2. How do you ascertain/select the attributes that are to be tackled? Q3. Would you like to go for Engineering Design factors or Industrial design factors or both? Q4. How do you develop a correlation matrix? Q5. How do you "Construct House of Quality"? Q6. What are the generic PD&D processes that you would like to adopt in re-designing it using House of quality? Q7. What are the methods that you would adopt for Market acceptance? Q8. How do you document the entire design process?
III	III. Based on Module No. 4. 3. Select any one consumer product, such as a) a mobile b) a laptop c) a pencil sharpener d) a table and chair e) a stool f) a bicycle g) a pen h) a storage device of any household items i) a cupboard etc…. anything Assume that you want to go for re-development of any one of the above products. How would you apply the creativity method to design the chosen product using any one creativity methods? Develop the product and document the entire process by answering some of the questions as shown in I or II.
IV	IV. Based on Module No. 5. 4. Select any one consumer product, such as a) a mobile b) a laptop c) a pencil sharpener d) a table and chair e) a stool f) a bicycle g) a pen h) a storage device of any household items i) a cupboard etc…. anything

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

	Assume that you want to go for re-development of any one of the above products. How would you apply the principles of Industrial Design methods to design the chosen product? Develop the product and document the entire process by answering some of the questions as shown in I or II.
V	V. Based on Module No. 6. 5. Select any one consumer product, such as a) a mobile b) a laptop c) a pencil sharpener d) a table and chair e) a stool f) a bicycle g) a pen h) a storage device of any household items i) a cupboard etc.…. anything Assume that you want to go for re-development of any one of the above products. How would you apply the principles of DFMA to design the chosen product? Develop the exploded view of the product and document the entire process by answering some of the questions as shown in I or II.

Recommended Books:
1. Baker, M. & Hart S. (2007), Product Strategy and Management, (2nd. Ed.) Edinburgh: Pearson Education.
2. Ulrich, K. & Eppinger, S. (2012), Product Design and Development. (5th. Ed.) Los Angeles: McGraw Hill Education.
3. Yousef Haik, T. M. M. Shahin (2010), Engineering Design Process, (2nd. Ed. Reprint), Cengage Learning, ISBN 0495668141.
4. Kevin Otto, Kristin Wood (2004), Product Design, (Indian Reprint), Pearson Education, ISBN 9788177588217.

Course Assessment:

Laboratory Work: (ISE)
    ISE-1:
    One Design Exercises and Two Assignment (20 Marks)
    ISE-2:
    Two Design Exercises and Two Assignments (25 Marks)
    Software Analysis (5 Marks)

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	T	P		L	T	P	Total
MEL802	Laboratory based on IoT	--	--	2		--	--	1	1
		Examination Scheme							
		ISE1	MSE		ISE2	ESE		Total	
		20	--		30	--		50	

Pre-requisite Course Codes	-	
Course Outcomes	CO1	Develop simple applications using microcontrollers 8051 and Arduino.
	CO2	Interface simple peripheral devices to a Microcontroller.
	CO3	Use microcontroller based embedded platforms in IoT.
	CO4	Use wireless peripherals for exchange of data.
	CO5	Setup cloud platform and log sensor data.

Sr. No.	Topics
1	Interfacing experiments using 8051 Trainer kit and interfacing modules a. display (LCD/LED/Seven Segment) b. Stepper / DC Motor
2	Introduction to Arduino platform and programming
3	Simple Applications using Arduino Development Board (Any two) a. Simple LED Blinking using development board b. Building IOT Smart Switch using IOT c. Pulse Width Modulation d. Analog to Digital / Digital to Analog Conversion
4	Interfacing Arduino with a Sensor (Any one): Temperature Sensor / PIR/ Ultrasonic sensor/ IR Sensor/ Flame Sensor/ MQ6 Sensor/ Humidity sensor/ Raindrop Sensor, magnetometers, cameras, accelerometers etc.
5	Interfacing Arduino with an Actuator (Any One): Motors / solenoids / Controllers etc.
6	Communication using Wireless Medium (Any One): WiFi / Bluetooth / Zigbee / RFID etc.
7	Setting up and Cloud Platform and logging Sensor Data on the platform.

Course Assessment:

Laboratory Work: (ISE)
    ISE-1: 3 experiments (20 marks)
    Continuous pre-defined rubrics-based evaluation
    ISE-2: Remaining 4 experiments (30 marks)
    Continuous pre-defined rubrics-based evaluation

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)				Credits Assigned			
		L	**T**	**P**		**L**	**T**	**P**	**Total**
		--	--	12#		--	--	6	6
MEP801	**Major Project II**	**Examination Scheme**							
		ISE1	MSE	ISE2		ESE		Total	
		20	--	30		100		150	

# indicates work load of Learner (Not Faculty)

Pre-requisite Course Codes		-
Course Outcomes	CO1	Students will be able to implement solutions for the selected problem by applying technical and professional skills.
	CO2	Students will be able to analyze impact of solutions in societal and environmental context for sustainable development.
	CO3	Students will be able to collaborate best practices along with effective use of modern tools.
	CO4	Excel in written and oral communication.
	CO5	Demonstrate capabilities of self-learning in a group, which leads to life long learning.
	CO6	Demonstrate project management principles during project work.

Guidelines:

1. Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.

2. Project Report Format:

At the end of semester, each group need to prepare a project report as per the guidelines issued by the University of Mumbai. Report should be submitted in hardcopy. Also, each group should submit softcopy of the report along with project documentation, implementation code, required utilities, software and user Manuals.
A project report should preferably contain at least following details:
o Abstract
o Introduction
o Literature Survey/ Existing system
o Limitation Existing system or research gap
o Problem Statement and Objective

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

o Proposed System

o Analysis/Framework/ Algorithm

o Design details

o Methodology (your approach to solve the problem) Proposed System

o Experimental Set up

o Details of Database or details about input to systems or selected data

o Performance Evaluation Parameters (for Validation)

o Software and Hardware Set up

o Results and Discussion

o Conclusion and Future Work

o References

o Appendix – List of Publications or certificates

Desirable
Students should be encouraged
o to participate in various project competition.
o to write minimum one technical paper & publish in good journal.
o to participate in national / international conference.

Course Assessment:

ISE-1: Continuous Evaluation by project guide followed by presentation before a panel of examiners based on predefined rubrics (20 marks)

ISE-2: Continuous Evaluation by project guide followed by presentation before a panel of examiners (30 marks)

ESE: Continuous Evaluation by project guide followed by presentation before a panel of examiners (100 marks)