



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with "A" Grade by NAAC

Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119.

Phone: 044 - 2450 3150 / 51 / 52 / 54 / 55 Fax: 044 - 2450 2344

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**SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
SCHOOL OF MECHANICAL ENGINEERING**

Department of Mechanical Engineering

Minutes of Board of Studies Virtual meeting held on 21th December 2020.

The following members were present in the meeting:

1. Dr.L.Vijayaraghavan, Professor- IIT Madras - External Member
2. Er.James Michael Amulu, Director- SAP - External Member
3. Dr.G.Arunkumar, Professor and Head- Mechanical Engineering - Internal Member
4. Dr.S.P.Venkatesan, Associate Professor- Mechanical Engineering - Internal Member
5. Dr.G.Senthilkumar, Associate Professor- Mechanical Engineering - Internal Member
6. Dr. J.Jayaprabhakar, Associate Professor- Mechanical Engineering- Internal Member
7. Dr.S.Ganesan, Associate Professor – Mechanical Engineering- Internal Member
8. Ms. Sanjana Kallat, Alumni- Internal Member.

At the outset, the Chair Person welcomed the members of BoS and placed the agenda for the deliberations of the members. The following deliberations were made as per the items of the circulated agenda.

1. Agenda item # 2 Addition of new Courses for Bachelors of Engineering– Mechanical Engineering

The Head of the department highlighted the feedback from the Alumni for the incorporation of elective courses in January 2021 to focus on emerging technologies and the feedback from Dr.L.Vijayaraghavan is to focus on Design of Heat Exchangers and Er.James Michael Amulu is to focus on Universal Human Values. Based on the feedback, Department proposed the following courses for the incorporation of the following courses.

Course 1: Design of Heat Exchangers

Course 2: Universal Human Values



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Resolutions:

The BOS resolved to recommend for approval of the suggested courses for inclusion in B.E Programme of Mechanical Engineering. Dr.L.Vijayaragahavan highlighted the importance of Design of Heat Exchangers and Er.James Michael Amulu highlighted the importance of Universal human Values and suggested to incorporate in core Courses.

3. Skilling in professional domains to promote industry ready competency among learners. Necessary certification courses to improve the domain knowledge.

Head pointed the workshop offered by the department such Six Sigma and Advanced Machining process

Resolutions:The BoS recommended the same to promote the industry ready competency among the students.

4..Any other points with the permission of Chair -Academic flexibilities with extra credits acquired through either advanced study of same courses or with procuring additional credits from additional courses as per student's choice - suggestion. Universal Human values was introduced as a mandate course

Head ask the suggestion to the External members for students undergoing specialization.

Resolutions: The BoS recommended that advanced courses/NPTEL courses and can be selected for the specialization. Also recommend that the students can opt these courses at the end of the third semester subject to the condition prescribed by the Board of Management time to time.

With the above discussion, the Head expressed his deep sense of gratitude to all members for an academic vibrant discussion on various matters. Since there was no other agenda, the meeting ended with the Vote of thanks to the Chair.



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Member	Designation	Signature
Dr.L.Vijayaraghavan	Professor	
Er.James Michael Amulu	Director	
Dr.G.Arunkumar	Professor and Head	
Dr.S.P.Venkatesan,	Associate Professor	
Dr.G.Senthilkumar	Associate Professor	
Dr. J.Jayaprabakar	Associate Professor	
Dr.S.Ganesan	Associate Professor	
Ms. Sanjana Kallat	Alumni Member	



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SMEA3020	DESIGN OF HEAT EXCHANGERS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To learn the thermal and stress analysis on various parts of the heat exchangers
- To analyze the sizing and rating of the heat exchangers for various applications

UNIT I INTRODUCTION

9 Hrs.

Types of heat exchangers, shell and tube heat exchangers – regenerators and recuperators - Temperature distribution and its implications - Parts description, Classification as per Tubular Exchanger Manufacturers Association (TEMA)

UNIT II PROCESS DESIGN OF HEAT EXCHANGERS

9 Hrs.

Heat transfer correlations, Overall heat transfer coefficient, analysis of heat exchangers – LMTD and effectiveness method. Sizing of finned tube heat exchangers, U tube heat exchangers, Design of shell and tube heat exchangers, fouling factors, pressure drop calculations.

UNIT III STRESS ANALYSIS

9 Hrs.

Stress in tubes - header sheets and pressure vessels - thermal stresses, shear stresses - types of failures, buckling of tubes, flow induced vibration.

UNIT IV COMPACT AND PLATE HEAT EXCHANGER

9 Hrs.

Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.

UNIT V CONDENSERS AND COOLING TOWERS

9 Hrs.

Design of surface and evaporative condensers - cooling tower - performance characteristics.

Course Outcomes:

Max. 45 Hours

On completion of the course, student will be able to

CO1: Classify Heat Exchangers based on TEMA.

CO2: Perform Heat transfer analysis by LMTD and NTU Methods.

CO3: Calculate stresses in heat exchanger tubes.

CO4: Design compact heat exchangers according to applications

CO5: Evaluate the performance characteristics of heat exchanger types

CO6: Design condensers and cooling towers according to need and applications..

TEXT BOOKS/ REFERENCES BOOKS

1. SadikKakac and Hongtan Liu, "Heat Exchangers Selection", Rating and Thermal Design, CRC Press, 2002.
2. Shah, R. K., Dušan P. Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.
3. Robert W. Serth, "Process heat transfer principles and applications", Academic press, Elsevier, 2007.
4. Sarit Kumar Das, "Process heat transfer", Alpha Science International, 2005
5. John E. Hesselgreaves, "Compact heat exchangers: selection, design, and operation", Elsevier science Ltd, 2001.



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END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration : 3 Hrs.

PART A: 10 questions of 2 marks each - No choice

20 Marks

PART B : 2 questions from each unit of internal choice; each carrying 16 marks

80 Marks

SAIC4003	UNIVERSAL HUMAN VALUES	L	T	P	Credits	Total Marks
		2	1	0	3	100

COURSE OBJECTIVES

- To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence
- To understand (or developing clarity) the harmony in the human being, family, society and nature/existence
- To strengthen self-reflection
- To develop commitment and courage to act

MODULE 1 COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration-what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self- exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

MODULE 2 UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF!

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure Sanyam and Health.
Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

MODULE 3 UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP

13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
14. Understanding the meaning of Trust; Difference between intention and competence
15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient

values in relationship

16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

MODULE 4 UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
21. Holistic perception of harmony at all levels of existence.

Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

MODULE 5 IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS

22. Natural acceptance of human values
23. Definitiveness of Ethical Human Conduct
24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
26. Case studies of typical holistic technologies, management models and production systems
27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
28. Sum up.

Practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Total: 28 Lectures and 14 Practice Sessions

COURSE OUTCOMES

On completion of the course, the student are expected

- CO1: To become more aware of themselves, and their surroundings (family, society, nature)
- CO2: They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind
- CO3: To have better critical ability
- CO4: To become sensitive to their commitment towards what they have understood (human values, human relationship and human society)
- CO5: To apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction

TEXT /REFERENCE BOOKS

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
6. Small is Beautiful - E. F Schumacher.
7. Slow is Beautiful - Cecile Andrews
8. Economy of Permanence - J C Kumarappa
9. Bharat Mein Angreji Raj - PanditSunderlal
10. Rediscovering India - by Dharampal
11. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
12. India Wins Freedom - Maulana Abdul Kalam Azad
13. Vivekananda - Romain Rolland (English)
14. Gandhi - Romain Rolland (English)

ASSESSMENT:

Assessment by faculty mentor: 10 marks

Self-assessment:: 10 marks

by peers: 10 marks

Socially relevant project/Group

Activities/Assignments: 20 marks Semester End Examination: 50 marks



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**SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
SCHOOL OF MECHANICAL ENGINEERING**

Department of Mechanical Engineering

Minutes of Board of Studies Virtual meeting held on 16th April 2021.

The following members were present in the meeting:

1. Dr.L.Vijayaraghavan, Professor- IIT Madras - External Member
2. Er.James Michael Amulu, Director- SAP - External Member
3. Dr.G.Arunkumar, Professor and Head- Mechanical Engineering - Internal Member
4. Dr.S.P.Venkatesan, Associate Professor- Mechanical Engineering - Internal Member
5. Dr.G.Senthilkumar, Associate Professor- Mechanical Engineering - Internal Member
6. Dr. J.Jayaprabhakar, Associate Professor- Mechanical Engineering- Internal Member
7. Dr.S.Ganesan, Associate Professor – Mechancial Engineering – Internal Member
8. Ms. Sanjana Kallat, Alumni- Internal Member.

At the outset, the Chair Person welcomed the members of BoS and placed the agenda for the deliberations of the members. The following deliberations were made as per the items of the circulated agenda.

1. Agenda item # 1 Modifications proposed for 2020 batch Bachelors of Engineering- Mechanical Engineering students in SMEA1402 – Mechanics of Machines.

Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made on SMEA1402– Mechanics of Machines.

(a) Removal of the following topics in Unit V- Gears, Path of contact, arc of contact and contact ratio– Gear trains Interchangeable gears – Gear tooth action – interference and undercutting – Gear trains – Epicyclic gear train – tabular method of finding velocity ratio.

(b) Inclusion of the following topics in Unit V: Effects of Gyroscopic Effects, Effect of precession motion on the stability of moving vehicles such as motor car, motor cycle (Demonstration of models in video)

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. G.Arunkumar pointed that the removal of topics was necessary. These topics are covered in Design of Transmission system. Then the members approved the



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modification in curriculum for consideration. The matter regarding the implementation of scheme from academic year 2020-21 batch onwards.

2. Agenda item # 2 Addition of new Course for 'Bachelors of Engineering- Mechanical Engineering'

The Head of the department highlighted the feedback from the Alumni for the incorporation of elective courses focus on emerging technologies and the feedback from Dr.L.Vijayaraghavan and Er.James Michael Amulu are to focus on Industry 4.0 Design and Manufacturing & Quality Control and Reliability Engineering. Based on the feedback, Department proposed the following courses for the incorporation of the following courses from July 2020 onwards.

Course 1: Industry 4.0 Design and Manufacturing

Course 2: Quality Control and Reliability Engineering

Resolutions: The BOS resolved to recommend for approval of the suggested courses for inclusion in B.E Programme of Mechanical Engineering. Dr.L.Vijayaraghavan and Mr.James Michael Amulu highlighted the importance of Industry 4.0 Design and Manufacturing & Quality Control and Reliability Engineering also suggested to incorporate in core Courses.

3. Skilling in professional domains to promote industry ready competency among learners. Necessary certification courses to improve the domain knowledge.

Head pointed the workshop offered by the department such as **Patent filing and Non Destructive Testing.**

Resolutions: The BoS recommended the same to promote the industry ready Competency among the students.

4. Any other points with the permission of Chair :

Academic flexibilities with extra credits acquired through either advanced study of same courses or with procuring additional credits from additional courses as per student's choice - suggestion. Universal Human values to be introduced as a mandate course

Head asked the suggestion to the External members for students undergoing specialization.

Resolutions: The BoS recommended that advanced courses/NPTEL courses and can be selected for the specialization. Also recommend that the students can opt these courses at the end of the fourth semester subject to the condition prescribed by the Board of Management time to time.



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With the above discussion, the Head expressed his deep sense of gratitude to all members for an academic vibrant discussion on various matters. Since there was no other agenda, the meeting ended with the Vote of thanks to the Chair.

Member	Designation	Signature
Dr.L.Vijayaraghavan	Professor	
Er.James Michael Amulu	Director	
Dr.G.Arunkumar	Professor and Head	
Dr.S.P.Venkatesan,	Associate Professor	
Dr.G.Senthilkumar	Associate Professor	
Dr. J.Jayaprabakar	Associate Professor	
Dr.S.Ganesan	Associate Professor	
Ms. Sanjana Kallat	Alumni Member	



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1. Agenda item # 1 Modifications proposed for SMEA1402 – Mechanics of Machines Course.

S.No	Existing Syllabus R2019	Corrected Syllabus
1	<p>UNIT V GEARS, GOVERNORS AND GYROSCOPES 9 Hrs</p> <p>Spur gear terminology - law of toothed gearing - Involute gearing - Path of contact arc of contact and contact ratio - Interchangeable gears - Gear tooth action - interference and undercutting - Gear trains - Epicyclic gear train - tabular method of finding velocity ratio. Governors - Types Centrifugal governors - Porter- Characteristics - Sensitivity - Stability - Hunting - Isochronisms - equilibrium speed Controlling - Force- Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in Aeroplanes</p>	<p>UNIT V GOVERNORS AND GYROSCOPES 9 Hrs</p> <p>Gyroscopes and gyroscopic effects-Effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships gyroscopic couple, (Demonstration of models in video). Governors - types and applications - Watt, porter and proell governors - spring loaded governors -Hartnell and Hartung with auxiliary springs. Sensitiveness- isochronisms and hunting.</p>

SMEA1402	MECHANICS OF MACHINES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Provide the insights of the fundamentals of Mechanisms and Cams.
- Understand the basics of Flywheels, Balancing of Rotating and Reciprocating unbalance systems.
- Enhance knowledge of Single degree - Free and Damped Vibrations.
- Provide the detailed overview of Forced Vibrations.
- Discuss the fundamentals of Gears, Gyroscopes and Governors.

UNIT 1 MECHANISMS AND CAMS**9 Hrs.**

Mechanisms – Terminology and definitions – Kinematics inversions of 4 bars and slider crank chain – Kinematic analysis in simple mechanisms. Types of cams and followers - Terminology and definitions – Displacement diagrams – SHM, uniform velocity, uniform acceleration and retardation. Graphical constructions of cam profiles – Disc cam with knife edge follower, roller follower and flat-faced follower.

UNIT 2 FLY WHEELS AND BALANCING**9 Hrs.**

Turning moment diagrams – Fluctuation of Energy and speed – Energy stored in Flywheel – Mass of Flywheel – Dimensions of Flywheel. Balancing – Static and Dynamic Balancing of Rotating Masses - Balancing of several masses rotating in same plane and in different planes- Partial Balancing of locomotives – Variation of tractive force, Hammer blow and swaying couple.

UNIT 3 FUNDAMENTALS OF VIBRATION**9 Hrs.**

Basic features of vibratory systems - Lumped mass systems - Degrees of freedom - Free vibration of Longitudinal, Transverse and Torsional systems of Single degree of freedom - Equations of motion - Natural frequency – Whirling of shafts and critical speed - Dunkerley's Method – Torsional vibration of Two and Three rotor system. Damped free vibration - Types of Damping –Critical damping coefficient - Damping Factor – Logarithmic Decrement.

UNIT 4 FORCED VIBRATION**9 Hrs.**

Forced vibration of single degree freedom system with damping - Response to periodic forcing- Harmonic Forcing - Force transmissibility and amplitude transmissibility - Reciprocating and rotating unbalance - vibration isolation and transmissibility - Support motion - self excited vibration with examples.

UNIT 5 GEARS, GOVERNORS AND GYROSCOPES**9 Hrs**

Spur gear terminology – law of toothed gearing – Involute gearing – Path of contact, arc of contact and contact ratio. Interchangeable gears – Gear tooth action – interference and undercutting – Gear trains – Epicyclic gear train – tabular method of finding velocity ratio. Governors - Types - Centrifugal governors – Porter– Characteristics –Sensitivity – Stability – Hunting – Isochronisms – equilibrium speed - Controlling Force- Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in Aeroplanes.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Recommend the cam and follower arrangement for the specific case study.
- CO2 - Examine the balancing of rotating and reciprocating unbalanced mass systems using analytical and graphical methods.
- CO3 - Design the flywheels for the specific mechanical system using analytical techniques.
- CO4 - Establish the free and/or forced vibration characteristics of the given mechanical system using analytical methods.
- CO5 - Predict the gyroscopic effects on the stability of the given moving vehicle analytically.
- CO6 - Compare the characteristics of governors for the specific automotive system.

TEXT/REFERENCE BOOKS

1. Khurmi R.S. & Gupta J.S, "Theory of Machines", 16th Edition, S.Chand & Company, 2005, Reprint 2016.
2. Singh V.P, "Mechanical Vibrations", 3rd Edition, Dhanpatrai & Co., 2006.
3. Ghosh A. and Malik A.M, "Theory of Mechanism and Machines", 4th Edition, Affiliated East West Press (P) Ltd., 2009.
4. Ashok G. Ambekar, "Mechanism and Machine Theory", 1st Edition, PHI Learning Private limited, 2009.
5. Rattan S. S, Theory of Machines, 3rd Edition, Tata McGraw Hill, 2009.
6. Gordon R Pennock, Joseph E Shigley, "Theory of Machine and Mechanisms" SI Edition, 4th Edition, Oxford University Press, 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 2 Questions each from CO1-CO4,1 question each from CO5 and CO6 – No choice**20 Marks****PART B:** 4 Questions each with internal choice from CO1-CO4,1 question from CO5 and CO6 with internal choice , each carrying 16 marks**80 Marks**

SMEA1402	MECHANICS OF MACHINES	Sc	Bo	To	Pd	Credits	Total Marks
			3	0	0	3	100

COURSE OBJECTIVES:

The aim of the course is to:

- Provide the insights of the fundamentals of Mechanisms and Cams.
- Understand the basics of Flywheels, Balancing of Rotating and Reciprocating unbalance systems.
- Enhance knowledge of Single degree - Free and Damped Vibrations.
- Provide the detailed overview of Forced Vibrations.
- Discuss the fundamentals of Gyroscopes and Governors.

UNIT I MECHANISMS AND CAMS

9 hrs

Mechanisms – Terminology and definitions – Kinematics inversions of 4 bars and slider crank chain – Kinematic analysis in simple mechanisms. Types of cams and followers - Terminology and definitions – Displacement diagrams – SHM, uniform velocity, uniform acceleration and retardation. Graphical constructions of cam profiles – Disc cam with knife edge follower, roller follower and flat-faced follower.

UNIT II FLY WHEELS AND BALANCING

9 Hrs

Turning moment diagrams – Fluctuation of Energy and speed – Energy stored in Flywheel – Mass of Flywheel – Dimensions of Flywheel. Balancing – Static and Dynamic Balancing of Rotating Masses - Balancing of several masses rotating in same plane and in different planes- Partial Balancing of locomotives – Variation of tractive force, Hammer blow and swaying couple.

UNIT III FUNDAMENTALS OF VIBRATION

9 Hrs

Basic features of vibratory systems - Lumped mass systems - Degrees of freedom - Free vibration of Longitudinal, Transverse and Torsional systems of Single degree of freedom - Equations of motion - Natural frequency – Whirling of shafts and critical speed - Dunkerley's Method – Torsional vibration of Two and Three rotor system. Damped free vibration - Types of Damping – Critical damping coefficient - Damping Factor – Logarithmic Decrement.

UNIT IV FORCED VIBRATION

9 Hrs

Forced vibration of single degree freedom system with damping - Response to periodic forcing- Harmonic Forcing - Force transmissibility and amplitude transmissibility - Reciprocating and rotating unbalance - vibration isolation and transmissibility - Support motion - self excited vibration with examples

UNIT V GOVERNORS AND GYROSCOPES

9 Hrs

Gyroscopes and gyroscopic effects-Effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships gyroscopic couple, (Demonstration of models in video). Governors - types and applications - Watt, Porter and Proell governors - Spring loaded governors -Hartnell and Hartung with auxiliary springs. Sensitiveness-isochronisms and hunting.

Max Hours: 45 Hrs

COURSE OUTCOMES:

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

- CO1:** Investigate the Mechanisms and Cams.
CO2: Determine the principle of Flywheel, Rotating and Reciprocating masses.
CO3: Analyze the Single degree - Free and Damped Vibrations.
CO4: Evaluate the force transmitted to the foundation for mechanical systems in Forced Vibrations.
CO5: Apply the fundamentals of Gyroscopes.
CO6: Apply the fundamentals of Governors

TEXT/REFERENCE BOOKS:

1. Khurmi R.S& Gupta J.S, "Theory of Machines", 16th Edition, S.Chand & Company, 2005, Reprint 2016.
2. Singh V.P, "Mechanical Vibrations", 3rd Edition, Dhanpatrai & Co., 2006.
3. Ghosh A. and Malik A.M, "Theory of Mechanism and Machines", 4th Edition, Affiliated East West Press (P) Ltd. 2009.
4. Ashok G. Ambekar, "Mechanism and Machine Theory", First Edition,PHI Learning Private limited, 2009.
5. Rattan S. S, Theory of Machines, 3rd Ed., Tata Mcgraw Hill, 2009.
6. Gordon R Pennock, Joseph E Shigley, "Theory of Machine and Mechanisms SI Edition, 4th Edition, Oxford University Press, 2014

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks:100

Exam Duration: 3 hrs.

Part A: 10 questions of 2 marks each – No choice

20 marks

Part B: 2 questions from each unit of internal choice, each carrying 16 marks

80 marks

SMEA4003	INDUSTRY 4.0 FOR DESIGN AND MANUFACTURING	L	T	P	Credits	Total Marks
		2	-	0	2	100

COURSE OBJECTIVES

- To enable students understand the fundamentals and the contributing technologies of Industry 4.0.
- To make the students evaluate the suitability of Industry 4.0 technologies for the design and Manufacturing sectors.
- To help the students implement the Industry 4.0 technologies to diverse applications.

UNIT 1 CONTRIBUTING TECHNOLOGIES 8 hrs

Brief introduction to the industrial revolutions. Contributing technologies to Industry 4.0: Additive manufacturing, Digital twin, Internet of things, Smart sensors, AR and VR, Artificial intelligence, Cloud computing, Block chain, Big data and analytics. Challenges and opportunities.

UNIT 2 ADVANCED CAD TECHNOLOGIES 8 hrs

Introduction to CAD. Enabling technologies: Digital twin, AR/VR, AI. Cloud computing, Touch/Voice/Motion enabled CAD, Customized CAD, Cloud based CAD, Digital twin and live simulation.

UNIT 3 SMART MANUFACTURING SYSTEMS 8 hrs

Enabling technologies: AI, Cloud computing, Robotics, IoT. Digital manufacturing: CNC, Cloud based manufacturing, IoT based manufacturing, Advanced CNC programming. Additive manufacturing. Micro electro mechanical systems. Robotics: Robotic automation, Collaborative robots, Autonomous robots, Swarm robots, and Modular robots.

UNIT 4 SMART FACTORY ENABLERS 8 hrs

Enabling technologies. Smart energy: Improving energy efficiency with data, Smart grids. Clean energy. Smart logistics. Smart Inspection. Smart decision making.

UNIT 5 AUTOMOMOUS VEHICLES 8 hrs

Introduction: Traditional mobility versus autonomous driving, Levels of automation, and challenges. Enabling technologies. Self-propelled vehicles, Drones, Unmanned aerial vehicles, Space crafts

UNIT 6 CASE STUDIES 5 hrs

Case studies related to Industry 4.0 applications, such as, transportation, energy, infrastructure, manufacturing, and product design sectors.

Max. 45 Hrs.

COURSE OUTCOMES

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

CO1: Justify how the digitalization technologies are advantageous to the design and manufacturing industries.

CO2: Use the advanced CAD technologies to create the CAD models.

CO3: Use the smart manufacturing technologies to produce the components and products.

CO4: Recommend the enabling technologies to make various factory operations smarter.

CO5: Choose the suitable sensors and technologies to the future autonomous vehicles, drones and space crafts.

CO6: Prepare a report with the challenges faced currently, the enabling technologies to become smarter, and the steps needed for the effective implementation for the given case study.

TEXT / REFERENCE BOOKS

1. Flavio Craveiro, Jose Pinto Duarte, Helena Bartolo and Paulo Jorge Bartolo, "Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0", Automation in Construction, Vol. 103, pp. 251- 267, 2019.
2. Klaus Schwab, "Fourth Industrial Revolution", Random House USA Inc, New York, USA, 2017.
3. Oliver Grunow, "Smart Factory and Industry 4.0. The current state of Application Technologies", Studylab Publications, 2016
4. Alasdair Gilchrist, "Industry 4.0: Industrial Internet of Things", Apress, 2016
5. Sang C. Suh, U. John Tanik, John N Carbone, Abdullah Eroglu, "Applied Cyber-Physical Systems", Springer Publications, New York, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 11 Questions of 2 marks each - No choice

22 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 13 marks

78 Marks

SMEA3021	QUALITY CONTROL AND RELIABILITY ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

(Use of approved statistical table permitted in the examination)

COURSE OBJECTIVES:

- To understand process control and acceptance sampling procedure and their application.
- To learn the concept of reliability.

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 9Hrs

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation –Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and chart - process capability – process capability studies and simple problems. Six sigma concepts

UNIT II PROCESS CONTROL FOR ATTRIBUTES 9Hrs

Control chart for attributes –control chart for non conforming– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT III ACCEPTANCE SAMPLING 9hrs

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer’s Risk and consumer’s Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT IV LIFE TESTING – RELIABILITY 9Hrs

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNIT V QUALITY AND RELIABILITY 9Hrs

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

Course Outcomes: Max. 45 Hours

On completion of the course, student will be able to

- CO1: Apply the concept of SQC in process control for reliable component production
- CO2: Perform statistical analysis using control charts
- CO3: Apply sampling techniques for non conformities
- CO4: Evaluate the quality of components by failure analysis
- CO5: Design for reliability of component parts
- CO6: Develop product analysis for new product development

TEXT BOOKS/ REFERENCES

1. Douglas.C. Montgomery, " Introduction to Statistical quality control", 4th edition, John Wiley 2001.
2. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 1991.
3. John.S. Oakland. "Statistical process control", 5th edition, Elsevier, 2005
4. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993
5. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996
6. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2001.
7. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration : 3 Hrs.

PART A: 10 questions of 2 marks each - No choice

20 Marks

PART B : 2 questions from each unit of internal choice; each carrying 16 marks

80 Marks