INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**Stress Analysis and Vibration**			
Course Code	BCC213			
Course Structure	Lectures	Tutorials	Practicals	Credits
	3	-	-	3
Course Coordinator	Dr. K. Viswanath Allamraju, Professor			
Team of Instructors	Dr. K. Viswanath Allamraju, Professor			

I. COURSE OVERVIEW

This course bridges gap between theory of elasticity and vibrations of free and forced types, it introduces the principles of elasticity, components of stresses and strains, differential equations of equilibrium, boundary conditions, compatibility conditions and stress function. This course also covers the two dimensional problems in rectangular coordinates and polar coordinates. This course covers the knowledge of vibrations of lumped and distributed parameter systems.

II. PREREQUISITE(S)

Level	Credits	Periods/ Week	Prerequisites
PG	3	3	Fundamentals of Engineering mechanics, Strength of materials and dynamics of machines.

III. MARKS DISTRIBUTION

Subject	SEE Examination	CIA Examination	Total Marks
Computer Aided Process Planning	70 Marks	30 Marks	100 Marks

Semester End Examination 70 Marks All the Units (1, 2, 3, 4 and 5)	70 Marks (3 Hours)	5 questions to be answered. Each question carries 14 Marks

<table>
<tr><td rowspan="6">Average of two CIA Examinations</td><td colspan="4">Continuous Internal Assessment (CIA) – 1</td></tr>
<tr><td rowspan="3">30 Marks
(2 Hours)</td><td rowspan="3">Units
I, II and
III (half)</td><td rowspan="2">Continuous Internal Examination (CIE)
(2 hours)
[4 questions to be answered out of 5 questions from Part- A & B]</td><td>Part – A
5 questions to be answered out of 5 questions, each carries 1 mark.</td></tr>
<tr><td>Part - B
4 questions each carry 5 marks.</td></tr>
<tr><td>Technical Seminar and Term Paper</td><td>5 marks</td></tr>
<tr><td colspan="4">Continuous Internal Assessment (CIA) - 2</td></tr>
<tr><td rowspan="3">30 Marks
(2 Hours)</td><td rowspan="3">Units
III (half)
IV and V</td><td rowspan="2">Continuous Internal Examination (CIE)
(2 hours)
[4 questions to be answered out of 5 questions from Part- A & B]</td><td>Part – A
5 questions to be answered out of 5 questions, each</td></tr>
<tr><td>Part - B
4 questions each carry 5 marks.</td></tr>
<tr><td>Technical Seminar and Term Paper</td><td>5 marks</td></tr>
</table>

IV. EVALUATION SCHEME

S. No	Component	Duration	Marks
1	CIE - I Examination	2 hour	25
2	Technical Seminar and Term Paper	10 minutes seminar and 1000 words document	05
TOTAL			30
3	CIE - II Examination	2 hour	25
4	Technical Seminar and Term Paper	10 minutes seminar and 1000 words document	05
TOTAL			30
CIA Examination marks to be considered as average of above two CIA's			
5	EXTERNAL Examination	3 hours	70
GRAND TOTAL			100

V. COURSE OBJECTIVES

The course should enable the students to

I. Understanding of modern trends in design and manufacturing using CAD/CAM.
II. Applying vibration theory for engineering.

I. COURSE OUTCOMES

At the end of the course the students are able to:

1. **Describe** the method of equations of motions of lumped mass parameter systems, distributed mass parameter systems by connecting the concepts of kinetics of particles and connected bodies.
2. **Identify** the process capabilities such as process parameters, process boundaries and machine performance, under the vibrations testing of mechanical, aeronautical, automobile, electrical and electronic assembly.
3. **Understand** the use of fundamentals of single, two and multi degree of freedom systems, continuous systems, stress analysis of symmetric bodies through the concepts of strength of materials and engineering dynamics to study the design of mechanical, aeronautical, automobile, electrical and electronic assembly under operation.
4. **Implement** manual and computer aided studies can be done for simulation studies of mechanical and aeronautical systems.

II. HOW PROGRAM OUTCOMES ARE ASSESSED

Program Outcomes		Level	Proficiency assessed by
PO1	**Engineering Knowledge:** Capability to apply knowledge of Mathematics, Science Engineering in the field of Mechanical Engineering	H	Seminar
PO2	**Problem Analysis:** An ability to analyze complex engineering problems to arrive at relevant conclusion using knowledge of Mathematics, Science and Engineering.	H	Seminar
PO3	**Design/ Development of solution:** Competence to design a system, component or process to meet societal needs within realistic	S	Projects
PO4	**Conduct Investigation of complex problems:** To design and conduct research oriented experiments as well as to analyze and implement data using research methodologies.	S	Projects
PO5	**Modern Tool usage:** An ability to formulate solve complex engineering problems using modern engineering and information technology tools.	S	Projects
PO6	**The Engineer society:** To utilize the engineering practices, techniques, skills to meet needs of health, safety legal, cultural and societal issues.	N	--
PO7	**Environment and Sustainability:** To understand the impact of engineering solution in the societal context and demonstrate the knowledge for sustainable development.	N	--
PO8	**Ethics:** An understanding and implementation of professional and Ethical responsibilities.	N	--
PO9	**Individual Team work:** To function as an effective individual and as a member or leader in multi-disciplinary environment and adopt in diverse	N	--
PO10	**Communication:** An ability to assimilate, comprehends, communicate, give and receive instructions to present effectively with engineering community and society.	N	--

Program Outcomes		Level	Proficiency assessed by
PO11	**Project Management and Finance:** An ability to provide leadership in managing complex engineering project at multi-disciplinary environment and to become a professional engineer.	N	--
PO12	**Life-Long learning:** Recognition of the need and an ability to engage in lifelong learning to keep abreast with technological changes.	S	Projects

III. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical system including allied engineering streams.	H	Lectures, Seminars
PSO2	**Design/ Analysis:** An ability to adapt and integrate current technologies in the design and manufacturing domain to enhance the employability.	S	Projects
PSO3	**Successful Career and Entrepreneurship:** To build the nation by imparting technological inputs and managerial skills to become a Technocrats.	S	Guest Lectures

N - None **S - Supportive** **H - Highly related**

IV. SYLLABUS

UNIT – I INTRODUCTION OF THEORY OF ELASTICITY

Two dimensional elasticity theory in Cartesian coordinates, plane stress problem in polar coordinates, Thick cylinders, Rotating discs, stress concentration.

UNIT – II STRESS ANALYSIS OF SYMMETRIC BODIES AND CONTACT STRESSES

Torsion of non circular prismatic sections, rectangular and axi-symmetric, circular plates, introduction to shell theory, contact stresses.

UNIT – III FREE AND FORCED VIBRATIONS

Single degree freedom, two degree freedom system without and with damping.
Free and forced vibrations, transient vibrations.

UNIT – IV TRANSIENT VIBRATIONS

Transient vibrations of single and two degree freedom systems, multi-degree of freedom systems, applications of matrix methods, continuous systems.

UNIT – V CONTINUOUS SYSTEMS

Free and forced vibrations of strings bars and beams, principle of orthogonality, classical and energy methods.

TEXT BOOKS

1. S.P. Timoshenko, J. N. Goodier, "Theory of Elasticity", Mc Graw Hill, 10 th Edition, 2016.

2. J. P. Den Hartog, "Mechanical Vibrations", Dover Publications, 3rd Edition, 2016.

REFERENCE BOOKS

1. W. T. Thomson, "Theory of Vibrations with Applications", CBS Publishing, 3rd Edition, 2013.
2. S. S. Rao, "Mechanical Vibrations", Addison Wesley Longman.

COURSE PLAN

At the end of the course, the students are able to achieve the following course learning outcomes.

Lecture No.	Course learning outcomes	Topics to be covered	Reference
1 – 3	**Identify and** understand of basic concepts of SAVV	Information requirement for theory of elasticity, role of elasticity, advantages of elasticity over SAVV, the information of degree of freedom	T2, R1
4 – 6	**Understand** and **Apply** concepts of Generative SAVV	Generative SAVV system: Importance, principle of generative SAVV system, and automation of logical decisions.	T1:2
7 – 9	**Apply** the concepts of group technology	Significance, group technology, structure, relative advantages, implementation and applications.	T2, R2, R1
10 – 13	**Understand** the selection of manufacturing sequences and optimal selection	Selection of manufacturing sequence: Significance, alternative manufacturing processes, reduction of total set up cost for a particular sequence, quantitative methods for optimal selection.	T1:4 R2
14 – 16	**Identify** the reasons for optimal selection of machining parameters.	Reasons for optimal selection of vibration parameters, effect of parameters on testing of machines.	T1:4
17 – 20	**Understand** the different approaches conventional approach and optimization	Different approaches, advantages of mathematical approach over conventional approach, solving optimization models of machining processes.	T1, R1
21 – 22	**Understand** and **apply** the tolerances for manufacturing and allocation of tolerance.	Design tolerances, manufacturing tolerances, methods of tolerance allocation,	T1, R1
23 – 25	**Develop** of design tolerance and manufacturing tolerance.	sequential approach, integration of design and manufacturing tolerances, advantages of integrated approach over	T1, R1

26 – 29	**Simulation** of machining process and **generate** tool path generation	Simulation of damped and undamped processes of motion of vibrations under various excitations.	T1,T1,R1
29 – 33	**Implementation** of latest trends in SAVV	Implementation techniques for SAVV: MIPLAN system, computer programming languages tbr SAVV, criteria for selecting a SAVV system and benefits of SAVV,	T1, R1
33– 36	**Apply** the concepts of computer integrated planning	computer integrated planning systems, and capacity planning system	T1, R1

XI MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	H	H										S	H	H	
II	S	H	H										S	H	
III	S	H	S										H		S
IV	H	S											H	S	
V	H	S											H	S	S

S - Supportive **H - Highly related**

XII MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H			S									H	S	
2	S	H	S									S	H		S
3	S	H			H								S		
4	H			S								S	S	S	
5	S	H	S		S							S	H		S
6	H	S		S									S		
7	H				H							S	H	S	
8	H			S									H	S	
9	S	H	S									S	H		S

S - Supportive **H - Highly related**

Prepared by: Dr. K.Viswanath Allamraju, Professor

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