RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Mechanical Engineering

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VISION AND MISSION OF THE INSTITUTE AND DEPARTMENT

VISION OF THE INSTITUTION

To Produce Professionally Excellent, Knowledgeable, Globally Competitive and Socially Responsible Engineers and Entrepreneurs.

MISSION OF THE INSTITUTION

M1	To Provide Quality Education in Engineering and Management.
M2	To Establish a Continuous Industry-Institute Interaction, Participation and Collaboration to Contribute Skilled Engineers.
M3	To Develop Human Values, Social Values, Entrepreneurship Skills and Professional Ethics among the Technocrats.
M4	To Focus on Innovation and Development of Technologies by Engaging in Cutting Edge Research areas.

VISION OF THE DEPARTMENT

To Produce Professionally Excellent, Knowledgeable, Globally Competitive, Socially Responsible Mechanical Engineers and Entrepreneurs.

MISSION OF THE DEPARTMENT

M1	To provide quality education in Mechanical Engineering and Management.
M2	To establish a continuous industry - institute interaction, participation and collaboration to contribute skilled Mechanical Engineers.
M3	To develop human values, socio-ethical values, entrepreneur skills and professional ethics among Mechanical Engineers.
M4	To focus on Research & Development (R & D) and Innovative Technologies by engaging in cutting edge research areas of Mechanical Engineering.

PROGRAM EDUCATIONAL OBJECTIVES (PEO'S)

PEO1	Graduates of Mechanical Engineering shall Develop Strong Academic Foundation for Successful Professional Career
PEO2	Graduates of Mechanical Engineering Acquires skills to excel in the area of Mechanical Engineering both in Industries and Academics
PEO3	Graduates of Mechanical Engineering Possess awareness towards Higher Education, R & D and Socio-Ethical values

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO 1	Graduates are able to Design, Analyze and Develop Mechanical Systems.
PSO 2	Graduates are Capable of Developing Research Skills in Self Sustainable Energy sources and Composite Materials.

PROGRAM OUTCOMES (PO)

PO 1	Engineering Knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem Analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/ Development of Solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in Independent and life-long learning in the broadest context of technological change.

Academic Calendar of VTU, Belagavi for EVEN Semester of 2019-2020 (Jan 2020 – July 2020)

	II Sem B. E. / B. Tech. / B. Arch	IV & VI Sem B. E. /B. Tech. IV, VI&VIII Sem B. Arch.	VIII Sem B.E / B.Tech & X Sem B. Arch	IV Sem MCA	VI Sem MCA	IV Sem MBA	IV Sem M. Tech.	IV Sem M. Arch.	II Sem M. Tech.	II Sem MCA	II Sem MBA	II Sem M. Arch.
Commencement of EVEN Semester	10.02.2020	10.02.2020	10.02.2020	27.01.2020	27.01.2020	10.02.2020	27.01.2020	27.01.2020	05.03.2020	05.03.2020	14.02.2020	14.02.2020
Last Working day of EVEN Semester	01.06.2020	01.06.2020	01.06.2020	20.05.2020	20.05.2020	01.06.2020	20.05.2020	20.05.2020	22.06.2020	22.06.2020	05.06.2020	05.06.2020
Practical Examination	03.06.2020 To 13.06.2020	03.06.2020 To 13.06.2020	-	26.05.2020 To 30.05.2020	-	-	-	-	25.06.2020 To 30.06.2020	25.06.2020 To 30.06.2020	-	-
Theory Examinations	15.06.2020 To 04.07.2020	15.06.2020 To 20.07.2020	03.06.2020 To 11.06.2020	03.06.2020 To 18.06.2020	-	03.06.2020 To 28.06.2020	03.06.2020 To 10.06.2020	-	01.07.2020 To 11.07.2020	01.07.2020 To 11.07.2020	08.06.2020 To 20.06.2020	09.06.2020 To 20.06.2020
Viva Voce	-	-	15.06.2020 To 20.06.2020	-	-	-	-	-	-	-	-	-
Summer Project / Professional training	-	-	-	-	22.05.2020 To 30.05.2020 (Submission of report to VTU)	01.04.2020 To 15.04.2020 (Submission of report to VTU)	12.06.2020 To 25.06.2020 (Submission of report to VTU)	-	13.07.2020 To 31.07.2020	-	23.06.2020 To 21.07.2020	01.07.2020 To 25.08.2020
Commencement of ODD Semester	27.07.2020	27.07.2020	27.07.2020	27.07.2020	-	-	-	-	03.08.2020	27.07.2020	27.07.2020	28.08.2020

NOTE

1. College Time Table shall be arranged for five and a half week days and planned to accommodate EDUSAT transmission slots, the schedule of which will be notified separately.
2. The faculty/staff shall be available to undertake any work assigned by the university.
3. If any of the above date is declared to be a holiday then the corresponding event will come into effect on the next working day.
4. Notification regarding Calendar of Events relating to the conduct of University Examination will be issued by the Registrar (Evaluation) from time to time.

10.1.2020.

REGISTRAR

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, B[illegible]LARI, 583104

CALENDAR OF EVENTS - B.E.(SECOND SEMESTER 2019-20) FEB - JULY 2020

DATE	FEBRUARY	DATE	MARCH	DATE	APRIL	DATE	MAY
1		1	SUNDAY	1	WEDNESDAY	1	FRI (May Day)
2		2	MONDAY	2	THURSDAY	2	SAT(PARENTS MEETING)
3		3	TUESDAY	3	FRIDAY	3	SUNDAY
4		4	WEDNESDAY	4	SATURDAY (Staff Meeting)	4	MONDAY
5	Student Induction Program (Phase II)	5	THURSDAY	5	SUNDAY	5	TUESDAY
6		6	FRIDAY	6	MON (Mahaveer Jayanthi)	6	WEDNESDAY
7		7	SATURDAY	7	TUESDAY	7	THURSDAY
8		8	SUNDAY	8	WEDNESDAY	8	FRIDAY
9	SUNDAY	9	MONDAY	9	THURSDAY	9	SATURDAY (Staff Meeting)
10	MONDAY	10	TUESDAY	10	FRIDAY (Good Friday)	10	SUNDAY
11	TUESDAY	11	WEDNESDAY	11	SATURDAY	11	MONDAY
12	WEDNESDAY	12	THURSDAY	12	SUNDAY	12	TUESDAY
13	THURSDAY	13	FRI (FIRST IA TEST)	13	MONDAY	13	WEDNESDAY
14	FRIDAY	14	SAT (FIRST IA TEST)	14	TUE (Ambetkar Jayanthi)	14	THURSDAY
15	SATURDAY (Staff Meeting)	15	SUN (FIRST IA TEST)	15	WEDNESDAY	15	FRIDAY
16	SUNDAY	16	MONDAY	16	THURSDAY	16	SATURDAY
17	MONDAY	17	TUESDAY	17	FRIDAY	17	SUNDAY
18	TUESDAY	18	WEDNESDAY	18	SAT(SECOND IA TEST)	18	MONDAY
19	WEDNESDAY	19	THURSDAY	19	SUN(SECOND IA TEST)	19	TUESDAY
20	THURSDAY	20	FRI (IA SUBMISSION)	20	MON(SECOND IA TEST)	20	WEDNESDAY
21	FRIDAY (Maha Shivarathri)	21	SATURDAY (Staff Meeting)	21	TUESDAY	21	THURSDAY
22	SATURDAY	22	SUNDAY	22	WEDNESDAY	22	FRI (THIRD IA TEST)
23	SUNDAY	23	MONDAY	23	THURSDAY	23	SAT (THIRD IA TEST)
24	MONDAY	24	TUESDAY	24	FRIDAY	24	SUN (THIRD IA TEST)
25	TUESDAY	25	WED (Chandramana Yugadi)	20	SAT (IA SUBMISSION)	25	MON (Ramzan)
26	WEDNESDAY	26	THURSDAY	26	SUNDAY	26	TUESDAY
27	THURSDAY	27	FRIDAY	27	MONDAY	27	WEDNESDAY
28	FRIDAY	28	SAT(PARENTS MEETING)	28	TUESDAY	28	THURSDAY
29	SATURDAY	29	SUNDAY	29	WEDNESDAY	29	FRIDAY
		30	MONDAY	30	THURSDAY	30	SAT ((3RD IA AND FINAL MARKS SUBMISSION)
		31	TUESDAY			31	SUNDAY
TOTAL	17 DAYS		25 DAYS		23 DAYS		24 DAYS

Sl.No.	COMMENCEMENT	LAST WORKING DAY	PRACTICAL/VIVA EXAM	THEORY EXAM
1	10/02/2020	01/06/2020	03-06-2020 To 13-06-2020	15-06-2020 To 07-07-2020

ODD SEMESTER WILL COMMENCE FROM 27 JULY, 2020.

08/07/2020
First Year Coordinator

Academic Dean

Principal

08/2/2020

V. V. SANGHA'S

RAO BAHADUR Y MAHABALESHWARAPPA ENGG COLLEGE, BALLARI – 583104.

(Formerly VIJAYANAGARA ENGINEERING COLLEGE)

CANTONMENT, BALLARI-583 104 (KARNATAKA).

DEPARTMENT OF MECHANICAL ENGINEERING

CALENDER OF EVENTS

ACADEMIC YEAR 2019 – 20 (EVEN SEMESTER) Feb – June 2020

Week (Session)	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Institution / Department Events	VTU Events / Holidays
	FEBRUARY 2020								
						1	2		
1ST	3	4	5	6	7	8	9	3rd HOD Meeting.	2nd Commencement of Semester UG
2ND	10	11	12	13	14	15	16		
3RD	17	18	19	20	21	22	23		21st Mahashivratri
4TH	24	25	26	27	28	29			
	MARCH 2020								
							1		
5TH	2	3	4	5	6	7	8	2nd HOD Meeting.	
6TH	9	10	11	12	13	14	15	13th, 14th &15th IA Test-I.	
7TH	16	17	18	19	20	21	22	18th SMS IA Marks & Attendance to Parents.	
8TH	23	24	25	26	27	28	29		25th Chandramana Ugadi .
9TH	30	31							
	APRIL 2020								
			1	2	3	4	5		
10TH	6	7	8	9	10	11	12	11th HOD Meeting.	6th Mahaveer Jayanthi. 10th Good Friday
11TH	13	14	15	16	17	18	19	18th, 19th & 20th IA Test-II.	14th Dr. B R Ambedkar Jayanthi.
12TH	20	21	22	23	24	25	26	25th SMS IA Marks & Attendance to Parents	21st Basava Jayanthi.
13TH	27	28	29	30					
	MAY 2020								
					1	2	3		1st May Day
14TH	4	5	6	7	8	9	10	4th HOD Meeting,	
15TH	11	12	13	14	15	16	17		
16TH	18	19	20	21	22	23	24	22nd, 23rd & 24th IA Test-III.	
	25	26	27	28	29	30	31	29th SMS Final IA Marks & Attendance to parents. 30th HOD Meeting.	25th Ramzan 01st Jun 2020 Last working day of UG

03.06.2020 to 11.06.2020 VTU **Theory** Examinations (B. E., **VIII** Semester).
15.06.2020 to 20.06.2020 VTU **Projects** Viva-Voce (B. E., **VIII** Semester).

03.06.2020 to 13.06.2020 VTU **Practical** Examinations (B. E., I, II, III, IV, V, VI & VII Semesters).
15.06.2020 to 20.07.2020 VTU **Theory** Examinations (B. E., I, II, III, IV, V, VI & VII Semesters).

25.06.2020 to 30.06.2020 VTU **Practical** Examinations (M. Tech, II Semester).
01.07.2020 to 11.07.2020 VTU **Theory** Examinations (M. Tech, II Semester).

03.06.2020 to 10.06.2020 VTU Theory Examinations M. Tech IV semester.
12.06.2020 to 25.06.2020 VTU **Project Report Submission** (M. Tech, IV Semester).

Head of the Department,
Mechanical Engineering Department.
R.Y.M. Engineering Collage,
Cantonment, BELLARY-583 104

V V SANGHA'S

RAO BAHADUR Y MAHABALESWARAPPA ENGINEERING COLLEGE, BELLARY

ACADEMIC YEAR 2019-2020(EVEN)

DEPARTMENT OF MECHANICAL ENGINEERING

TIME TABLE

CLASS : 6th SEM- A SECTION **W.E.F : 10 FEB 2020** **ROOM No : LH-10**

DAYS	09:00 AM to 09:55 AM	09:55 AM to 10:50 AM	10:50 AM to 11:00 AM	11:00 AM to 11:55 AM	11:55 AM to 12:50 PM	12:50 PM to 02:15 PM	02:15 PM to 03:10 PM	03:10 PM to 04:05 PM	04:05 PM to 05:00 PM
MONDAY	MF/AE	TQM/IS	BREAK	FEA	CIM	LUNCH BREAK	HT LAB(A1)/M &A LAB(A3)		
TUESDAY	TQM/IS	MF/AE		HT	DME II		FEA	DME II	HT
WEDNESDAY	FEA	HT		DME II	DME II		HT LAB(A2)/M &A LAB(A1)		
THURSDAY	DME II	CIM		FEA	HT		CIM	HT(T)	FEA
FRIDAY	HT	HT LAB(A3)/M &A LAB(A2)					TQM/IS	MF/AE	DME II
SATURDAY	CIM	TQM/IS		FEA	MF/AE				

BATCH LIST: A1 = ROLL No. 1-25, A2 = ROLL No. 26-50, A3 = ROLL No. 51-TILL END.

SL. No.	SUBJECT CODE	SUBJECT	STAFF
1	17ME61	FEA	V.Balaraj
2	17ME62	CIM	Kotresh Sarda / N Swamy
3	17ME63	HT	Dr Shiva Kumar Modi
4	17ME64	DME-II	Dr. Rohi Nagraj / H M Naveen
5	17ME653	MF	D Ramesh
6	17ME655	AE	P K Pavan Kumar
7	17ME662	IS	K C Mahindra/ G. Mahesh
8	17ME663	TQM	Manjunath K B
9	17MEL67	HT LAB	Dr Shiva Kumar Modi/ G. Mahesh
10	17MEL68	M & A LAB	V.Balaraji/G Manjunath Swamy
	class coordinater		B Basava Prakash

SL. No.	EVENTS	DATE
	COMMENCEMENT OF 6th SEM	10-Feb-19
	1ST IA TEST	
	2ND IA TEST	
	3RD IA TEST	
	LAST WORKING DAY	
	COMMENCEMENT OF PRACTICAL EXAM	
	COMMENCEMENT OF THEORY EXAM	

CO-ORDINATOR

HOD

Head of the Department,
Mechanical Engineering Department
R.Y.M. Engineering Collage,
Cantonment, BELLARY-583 104

PRINCIPAL

PRINCIPAL
R.Y.M. Engineering College,
(Formerly Vijayanagar Engg. College)
Cantonment, BELLARY-583 104

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
Department of Mechanical Engineering

VTU, COLLEGE AND DEPARTMENT CALENDAR 2019-20

INDIVIDUAL TIME TABLE 2018-19

Staff Name: Prof. Balaraj V (VB) **Subjects: FEA(6A), ½ AE(6B),M&A LAB(6A)**

DAY	9.00-9.55	9.55-10.50	Break	11.00-11.55	11.55-12.50	LUNCH (12.50 – 2.15)	2.15-3.10	3.10-4.05	4.00-5.00
MON	AE			FEA			M&A LAB		
TUE							FEA		
WED	FEA						M&A LAB		
THUR				FEA					FEA
FRI		M&A LAB						AE	
SAT				FEA					
ADDITIONAL WORK	IA Test time table , Off – Campus Details,Criteria III								

ALLOTMENT WEIGHTED POINTS:

Sl#	Work Load Allotment	Points
1	1 1/2 Subjects * 08 (2 Points for each Class)	16
2	Lab Work *3 (3Point for each lab)	09
3	Additional Work (1 Point for each Coordination Work)	03
	TOTAL Work Load (in points)	**28**

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Cantonment, BELLARY-583 104

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Department of Mechanical Engineering

SYLLABUS COPY 2019-20

FINITE ELEMENT ANALYSIS

Module-1: Introduction to Finite Element Method

General description of the finite element method. Engineering applications of finite element method. Boundary conditions: homogeneous and no homogeneous for structural, heat transfer and fluid flow problems. Potential energy method, Rayleigh Ritz method, Galerkin's method, Displacement method of finite element formulation. Convergence criteria, Discretization process, Types of elements: 1D, 2D and 3D, Node numbering, Location of nodes. Strain displacement relations, Stress strain relations, Plain stress and Plain strain conditions, temperature effects.

Interpolation models: Simplex, complex and multiplex elements, Linear interpolation polynomials in terms of global coordinates 1D, 2D, 3D Simplex Elements. **10 hours**

Module-2

Interpolation models: One-Dimensional Elements-Analysis of Bars and Trusses, Linear interpolation polynomials in terms of local coordinate's for1D, 2Delements. Higher order interpolation functions for 1D quadratic and cubic elements in natural coordinates,Constant strain triangle, Four-Nodded Tetrahedral Element (TET 4), Eight-Nodded Hexahedral Element (HEXA 8), 2D isoperimetric element, Lagrange interpolation functions, Numerical.

Integration: Gaussian quadrature one point, two point formulae, 2D integrals. Fore terms: Body force, traction force and point loads.

Numerical Problems: Solution for displacement, stress and strain in 1D straight bar, stepped bars and tapered bars using elimination approach and penalty approach, Analysis of trusses. **10 hours**

Module-3

Beams and Shafts:

Boundary conditions, Load vector, Hermite shape functions, Beam stiffness matrix based on Euler-Bernoulli beam theory, Examples on cantilever beams, propped cantilever beams, Numerical problems on simply supported, fixed straight and stepped Beams using direct stiffness method with concentrated and uniformly distributed load.

Torsion of Shafts: Finite element formulation of shafts, determination of stress and twists in circular shafts. **10 hours**

Module-4

Heat Transfer: Basic equations of heat transfer: Energy balance equation, Rate equation: conduction, convection, radiation, energy generated in solid, energy stored in solid, 1D finite element formulation using vibration method, Problems with temperature gradient and heat fluxes, heat transfer in composite sections, straight fins. **10 hours**

Module-5:

Axi-symmetric Solid Elements: Derivation of stiffness matrix of Axisymmetric bodies with triangular elements, Numerical solution of Axisymmetric triangular element(s) subjected to surface forces, point loads, angular velocity, pressure vessels.

Dynamic Considerations: Formulation for point mass and distributed masses, Consistent element mass matrix of one dimensional bar element, truss element, Axisymmetric triangular element, quadrilateral element, beam element. Lumped mass matrix of bar element, truss element, Evaluation of Eigen values and Eigen vectors, Applications to bars, stepped bars, and beams. **10 hours**

Course Objectives:

1	To Implement the equilibrium equations subjected to body force, traction forces on 2-D and 3-D problems & displacement, stress – strain relations for plane stress & plane strain problems.
2	To Explain the general description of Principle of minimum P.E, Problems Rayleigh – Ritz method &Galerkin's method Euler's Lagrange's equations of Bar & Beams, Principle of Virtual Work.
3	To be explain and provides a systematic procedure for the derivation of the approximation function over sub regions of the domain and with the application of the boundary conditions the unknown values of the sub region is determined.
4	Able to determine the displacement, stress and reaction in the bars and truss by using penalty approach and elimination approach.
5	Able to write the Lagrange's interpolation, Higher order elements their shape functions. Gauss-elimination technique, Numerical integration: 1, 2 and 3 gauge point for 1D and 2D cases.
6	To write the Hermit shape functions, stiffness matrix for beam element, To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses.

Teaching and Learning Tools: Blackboard/PowerPoint presentation/webinar/lab/any best practice

Head of the Department,
Mechanical Engineering Department
R.Y.M. Engineering College,
Cantonment, BELLARY-583 104

COs, CO-PO MAPPING AND JUSTIFICATION 2019-20

CO's	DESCRIPTION
17C309.1	Understand the concepts behind formulation methods in FEM.
17C309.2	Identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.
17C309.3	Develop element characteristic equation and generate global equation.
17C309.4	Apply suitable boundary conditions to a global equation for static and dynamic problems.
17C309.5	Evaluate displacements, stress and strains for different mechanical elements.

CO-PO/PSO MAPPING

PO's / CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
17C309.1	2	3	3	2				2				
17C309.2	2	3	3	3				2				1
17C309.3	3	3	3	3				2				2
17C309.4	3	3	3	3				2				2
17C309.5	3	3	3	3				2				2

***Note:** - 1.Slight (Low) 2.Modarate (Medium) 3.Substantial (High).

COURSE COMMITTEE
CC
MECH
RYMEC

PROGRAM ASSESSMENT COMMITTEE
PAC
MECH
RYMEC

JUSTIFICATION FOR THE CO WITH THE PO (1-12)

Justification for the CO with the PO (1-12)

PO1: All the contents of this subject are based on the knowledge of science, mathematics and fundamentals of engineering, therefore the entire CO's are mapped with high correlation 3. The CO1& CO2 is mapped with correlation 2

PO2: The students apply the knowledge of engineering to formulate and analyze the problems. Hence all the CO's are mapped with high correlation 3 only.

PO3: The students will be able to design and develop the solution for complex engineering problems. Therefore all CO's are mapped with high correlation 3 .

PO4: Students are able to design and develop the mathematical solutions for various complex problems related to finite element methods. The entire CO's is mapped with high correlation 3 and CO1 is mapped with correlation 2.

PO5: Students are not to use modern tools for analyzing the complex problems of real life applications. Therefore none of the CO's is mapped.

PO6: Social and health issues are not addressed by any of the Module. Therefore none of the CO's is mapped.

PO7: Environmental and sustainability is not addressed by any of the Module. Therefore none of the CO's is mapped.

PO8: There is scope of in depth learning in the field of structural and dynamic analysis with ethics. All CO's are mapped with correlation 2.

PO9: Team work is not addressed by any of the module. Therefore none of the CO's is mapped.

PO10: Communication is not addressed by any of the exercise. Therefore none of the CO's is mapped.

PO11: Project management and finance is not addressed by any one of the exercise. Therefore none of the CO's is mapped.

PO12: There is scope of in depth learning in the field of structural and dynamic analysis. All CO's are mapped with correlation 2.

CO-PSO Mapping Matrix

PSO's / CO's	PSO1	PSO2
17C309.1	3	2
17C309.2	2	3
17C309.3	2	2
17C309.4	1	2
17C309.5	3	3

***Note: - 1.Slight (Low) 2.Modarate (Medium) 3.Substanial (High).**

JUSTIFICATION FOR THE CO WITH THE PSO (1-2)

PSO1: Students are able to identify, design, analyze and develop mechanical elements satisfactorily. Hence all the CO's are mapped with PSO1.

PSO2: With the knowledge of Finite element analysis students can be able to develop research skill in composite materials. Hence all the CO's are mapped with PSO2.

COURSE COMMITTEE CC MECH RYMEC

Head of the Department,
Mechanical Engineering Department,
R.Y.M. Engineering Collage,
Cantonment, BELLARY-583 104

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
Department of Mechanical Engineering

STUDENTS LIST

Ro. No.	USN	Name of the Student	Ro. No.	USN	Name of the Student
A-1	3VC16ME007	ABHISHEK SINHA	A-33	3VC17ME049	PAVAN KUMAR B
A-2	3VC17ME001	AJAY REDDY N	A-34	3VC17ME054	PAVITHRA R
A-3	3VC17ME002	AKASHA GOUDA H	A-35	3VC17ME081	VINAY KUMAR S
A-4	3VC17ME003	ANIL KITTUR	A-36	3VC17ME425	S MUSHTAQ AHMED
A-5	3VC17ME004	BHARATHISHA A B	A-37	3VC18ME401	ANAND K R
A-6	3VC17ME005	BHARGHAV R	A-38	3VC18ME402	ANIL KUMAR V
A-7	3VC17ME006	C ESHWAR	A-39	3VC18ME411	H M UDAY KUMAR
A-8	3VC17ME007	DEEPAK PATIL S R	A-40	3VC18ME413	IMRAN ABDUL W B
A-9	3VC17ME008	DODDA BASAVA B	A-41	3VC18ME415	K VINAY KUMAR
A-10	3VC17ME009	DURJAYA K B	A-42	3VC18ME418	KIRAN KUMAR D
A-11	3VC17ME010	EARESH VARMA C	A-43	3VC18ME420	KUMAR K
A-12	3VC17ME012	ERANAGOUDA K M	A-44	3VC18ME423	MADHUSUDHAN B
A-13	3VC17ME014	G RANJITH	A-45	3VC18ME424	MAHANTESH H M
A-14	3VC17ME016	G S SREE HARSHA	A-46	3VC18ME425	MANIKANTA K
A-15	3VC17ME018	GANESH GOWDA M	A-47	3VC18ME431	MULLA ALTAF HUSSAIN
A-16	3VC17ME019	GANESH J	A-48	3VC18ME433	NISAR AHAMED K M
A-17	3VC17ME020	GURUSIDDANA GOUDA B	A-49	3VC18ME434	G PAVAN KALYAN
A-18	3VC17ME021	HAMPANNA	A-50	3VC18ME435	PAVITHRA K
A-19	3VC17ME022	HANUMESH	A-51	3VC18ME441	SAGAR MP
A-20	3VC17ME023	J M ABDUL KHADER BASHA	A-52	3VC18ME443	SAMPATH KUMAR Y M
A-21	3VC17ME024	JAGADEESH	A-53	3VC18ME444	SANTOSH G
A-22	3VC17ME025	JEFFREY SUJAN KUMAR K	A-54	3VC18ME446	K SHIVA KUMAR
A-23	3VC17ME027	K M PARIKSHITH	A-55	3VC18ME449	SHIVA SHANKAR ADUR
A-24	3VC17ME028	KAISARAHMED D	A-56	3VC18ME454	THIPPESWAMY B
A-25	3VC17ME029	KARTHIK KUMAR D	A-57	3VC18ME455	THIPPESWAMY R
A-26	3VC17ME030	KARTHIK R B	A-58	3VC18ME457	V SIDDHI VINAYAKA
A-27	3VC17ME031	KIRAN MATH	A-59	3VC18ME459	VINOD KUMAR B
A-28	3VC17ME032	LOKESHA NAIK	A-60	3VC18ME460	VISHWANATH H
A-29	3VC17ME033	M CHAITANYA	A-61	3VC18ME461	VISHWANATH GOWDA K
A-30	3VC17ME041	MOHAMMED AZAM J	A-62	3VC18ME462	VYSHNAVI
A-31	3VC17ME043	MOHAN E	A-63	3VC18ME464	YESHWANTH D
A-32	3VC17ME046	NAVEEN SURAGOUNI			

COURSE COMMITTEE
MECH
RYMEC

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Mechanical Engineering Department
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Cantonment, BELLARY-583 104

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
Department of Mechanical Engineering

COURSE PLAN 2019-20 (Even Sem)

Staff Name: Mr.V BALARAJ	**Course Type: Core**	**Sem / Sec: 6th A**
Course Name: FINITE ELEMENT ANALYSIS	**Course Code: 17ME61 / 17C309**	**Total No. of Lecture Hours: 52**
Max marks: 60	**Prerequisites:** ENGG MATHS (15ME31/41) AND MECHANICS OF MATERIALS (15ME34)	

Sl.No	Module Name	Hours Required	Assessment Strategy
01	Introduction to Finite Element Method and Interpolation models	10 Hrs	CIE , SEE
02	Interpolation models, Integration and Numerical Problems	10Hrs	CIE , SEE
03	Beams and Shafts and Torsion of Shafts	10 Hrs	CIE , SEE
04	Heat Transfer	10Hrs	CIE , SEE
05	Axi-symmetric Solid Elements and Dynamic Considerations	12Hrs	CIE , SEE

Assessment Strategy:

Assignment	CIE	SEE	Seminar
Mention if any other required:			

Teaching and Learning Tools: Blackboard/PowerPoint presentation.

TEXT BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	**Finite Elements in Engineering**, T.R.Chandrupatla, A.D Belegunde,3rd Ed PHI
T2	**Finite Element Method in Engineering**, S.S. Rao, 4th Edition, Elsevier, 2006.
T3	**Finite element method,** Logan, D. L., A 6th Edition, Cengage Learning, 2016.
R1	**"Finite Element Methods for Engineers"** U.S. Dixit, Cengage Learning, 2009
R2	**Concepts and applications of Finite Element Analysis**, R.D. Cook D.S Maltus, M.E Plesha, R.J.Witt, Wiley 4th Ed, 2009
R3	**Finite Element Methods**, Daryl. L. Logon, Thomson Learning 3rd ,edition, 2001.
R4	**Finite Elements Method,** J. N. Reddy, McGraw- Hill International Edition.
	T- Text Book. R-Reference Book, AR – Additional Reference

Digital Library:

SI	Web Details
1	\\192.168.8.4\gdlc1\EngineeringLibrary-1
2	http://nptel.iitm.ac.in/
3	http://vtu.ac.in/elearning/
4	onlinelibrary.wiley.com
5	Freevideolectures.com
6	Youtube.com (videos)

Contents beyond Syllabus:

S.No	Topics
01	Advanced meshing and simulation software's must be introduced in the lab.
02	Numerical examples of the application of FEM to fluid flow called FVM.
03	Mathematical Concepts like Matrices, Integrations, Differentiation, Euler's, Lagrangian equations.

Assessment Strategy: (Tick any of the following)

Assignment	I.A Test	Final Exam
Seminar	Mention if any other required:	

Note: Planning of syllabus to be covered as per units given in VTU syllabus

Staff Sign

Head of the Department,
Mechanical Engineering Department
R.Y.M. Engineering College
Cantonment, Ballari-583 104

PERIODIC LESSON PLAN 2019-2020

Staff Name: BALARAJ V	Sem: VI	Sec: B
Course Name:FINITE ELEMENT ANALYSIS	Course Code:15ME61	Total Contact Hours:52 TO 54
Lesson plan author name: BALARAJ V	Evaluated by: S K MODI	Date:

Module	Topic to be covered	Topic Learning outcome (TLO)	Hrs
Part- A			
Students are able to....			
1	Review mechanics and Matrices: Engineering applications of FEM, Equilibrium equation in elasticity, Conclusion. Strain- displacement relation for pane stress plane strain and 3-D.	Understand and write the Equilibrium equation in elasticity. Recall and write the Strain- displacement relation for pane stress plane strain, 3-D problems.	1
	Review, Stress strain relations for plane stress & plane strain, problems on above topics, Conclusion. General description of FEM, Discretization process, Conclusion.	Define and write the Stress strain relations for plane stress & plane strain problems and UnderstandGeneral description of FEM, Discretization process.	1
	Types of elements 1D, 2D, & 3D elements, Size of elements, Location of nodes, Node numbering scheme, Half band width, Properties of stiffness matrix Conclusion.	Understand the types of elements and size of elements and Location of nodes, Node numbering scheme, Half band width, Properties of stiffness matrix.	1
	Pre-processing, Post processing, Stiffness matrix of bar element by direct method, Review, Boundary conditions, Initial conditions, Euler's Lagrange's equations of Bar &Beams, Principle of Virtual Work. Conclusion.	Understand Pre-processing, Post processing, Stiffness matrix of bar element by direct method and Boundary conditions, Initial conditions and Euler's Lagrange's equations of Bar &beams, Principle of Virtual Work.	1
	Review, Principle of minimum P.E, Problems Conclusion.	Explain Principle of minimum Potential energy.	1
	Review, Rayleigh – Ritz method &Galerkin's method.	UnderstandRayleigh – Ritz method &Galerkin's method.	1
	Problems on Rayleigh – Ritz method	Solve the problems on Rayleigh – Ritz method.	1
	Problems on Galerkin's method.	Solve the Problems on Galerkin's method.	1
	More problems on above methods	Solve the Problems on Rayleigh – Ritz and Galerkin's method	1
	Review, Linear interpolation polynomials in terms of global, natural and local, co-ordinates of bar.	Write Linear interpolation polynomials in terms of global, natural and local, co-ordinates.	1
	Shape functions and Nodal load vector, Strain displacement matrix for linear element.	Interpret the Shape functions and Nodal load vector, Strain displacement matrix for linear element.	1

	Revive Module 1 ,Introduction to interpolation function, Simplex complex and multiplex elements, Selection of the order of the interpolation polynomial Conclusion	Understand the interpolation function, Simplex complex and multiplex elements.	1
	Review, Convergence requirements, 2D Pascal triangle, Conclusion.	Understand the Convergence requirements and write2D Pascal triangle.	1
	Shape functions and Nodal load vector, Strain displacement matrix	Understand the Shape functions and Nodal load vector, Strain displacement matrix.	1
	CST elements-Shape functions in terms global, natural and local, co-ordinates of bar and Nodal load vector, Strain displacement matrix, Jacobian for triangular and rectangular element.	Interpret the Shape function sin terms global, natural and local, co-ordinates for CST elements and Interpret the Nodal load vector, Strain displacement matrix, Jacobian for triangular and rectangular element for CST elements..	1
	Lagrange's interpolations, higher order one dimensional elements, shape functions Iso sub and Super parametric elements.	Understand the Lagrange's interpolation, higher order one-dimensional elements and Compare the Iso sub and Super parametric elements.	1
	Shape function of 2-D quadrilateral element-linear, quadric element (9 noded and 8 noded elements).	Interpret the Shape function of 2-D quadrilateral element-linear, quadric element (9 noded and 8 noded elements).	1
2	Numerical integration: 1, 2 and 3 gauge point for 1D , 2D cases and Problems on numerical integration: 1, 2 and 3 gauge point for 1D case.	Compare the Numerical integration: 1, 2 and 3 gauge point for 1D , 2D cases and Evaluate numerical integral (I) by using 1, 2 and 3 gauge point for 1D case.	1
	Review unit3, Introduction to BC's, of elimination method & penalty method.	Explain the elimination method & penalty method of boundary condition.	1
	Problems on bars and stepped bars with point load for displacements, reactions and stresses by using penalty approach.	Evaluate the displacements, reactions and stresses in Bars subjected to point load by penalty approach.	1
	Problems on bars and stepped bars with point load for displacements, reactions and stresses by using elimination approach.	Evaluate the displacements, reactions and stresses in Bars subjected to point load by using elimination approach.	1
	Problems on uniform varying bars with point load and body force (density), and surface forces (Temperature effect on bars) and bars with gap for displacements, reactions and stresses by using elimination approach and penalty approach.	Evaluate the displacements, reactions and stresses in uniform varying bars subjected to point load and body force (density) surface forces (Temperature effect on bars) by using elimination approach.	1
	Assumption, direction of cosines and Derivation of Element Stiffness Matrices.	Illustrate the Elemental stiffness matrix with assumptions.	1

	Numerical problems on Trusses.	Evaluate the displacements, reactions and stresses in trusses subjected to load at nodes.	1
3	Review Module 2: Introduction to beam element and Hermit shape functions beam element.	Understand the beam element and Interpret the Hermit shape functions of beam element.	1
	Stiffness matrix and load vector of functions beam element.	Illustrate stiffness matrix and load vector of beam element	1
	Numerical problems of fixed beams, simply supported beams carrying concentrated load and UDL.	Evaluate the deflection and shape function of fixed beams and simply supported beams carrying concentrated loads UDL.	1
	Numerical problems of cantilever beams carrying concentrated load and linearly varying loads.	Evaluate the deflection and shape functions of cantilever beams carrying concentrated load and linearly varying loads.	1
	Numerical problems of beams carrying concentrated, UDL and Couple.	Evaluate the deflection and shape functions beams carrying concentrated, UDL and Couple.	1
	Review of Torsional equations; understand finite element formulation of shaft.	Understand the shaft element and derive finite element formulation of shaft.	1
	Numerical problems of solid uniform and stepped bar of circular section subjected to torque.	Evaluate the angle of twist and shear stresses in the shaft of solid uniform and stepped bar of circular section subjected to torque.	1
	Numerical problems of composite step shaft consist of different sections and hallow subjected to torque.	Evaluate the angle of twist and maximum shear stresses in the composite step shaft consist of different sections and hallow subjected to torque.	1
4	Introduction to heat transfer, Steady state heat transfer.	Understand the heat transfer, Steady state heat transfer.	1
	Review, 1D heat conduction governing equation.	Illustrate the1D heat conduction governing equation.	1
	Review, Boundary conditions, One dimension element and Galerkin approach for heat conduction.	Explain the Boundary conditions, One dimension element and Galerkin approach for heat conduction.	1
	Heat flux boundary condition,1D heat transfer in thin fins	Explain the Heat flux boundary condition, 1D heat transfer in thin fins.	1
	Problems on 1D heat conduction Galerkin approach with free end convection.	Evaluate the heat transfer distribution in bar elements with free end convection.	1
	Problems on 1D heat convection and transfer in thin fins with and without insulation.	Evaluate the heat transfer distribution in fin elements with and without insulation.	1

	Problems on 1D heat conduction with internal heat generation.	Evaluate the heat transfer distribution in bar and fins elements with internal heat generation.	1
	Flow through a porous medium	Explain the Flow through a porous medium.	1
	Flow through pipes of uniform sections	Explain the Flow through pipes of uniform sections.	1
	Flow through pipes of stepped Sections.	Explain the Flow through pipes of stepped sections.	1
	Problems on porous medium	Evaluate the porous medium	1
	Problems on of uniform sections and stepped Sections.	Evaluate the uniform sections and stepped Sections.	1
5	Revive of Mechanical vibration; Formulation for point mass and Consistent element mass matrix of one dimensional bar element	Formulate Consistent element mass matrix of one dimensional bar element	2
	Formulation for Consistent element mass matrix of truss element.	Formulate Consistent element mass matrix of truss element.	2
	Formulation for Lumped mass matrix of bar element, truss element.	Formulate for Lumped mass matrix of bar element, truss element.	2
	Problems Eigen vectors and Eigen values and natural frequency of vibration of a Bars.	Evaluate Eigen vectors , Eigen values and natural frequency of vibration uniform bars, stepped bars and then Draw mode shapes.	2
	Problems Eigen vectors and Eigen values and natural frequency of vibration of a cantilever Beams	Eigen vectors, Eigen values and natural frequency of vibration uniform beam then Draw mode shapes.	2

Signature of Staff member

Signature of HOD

Note: Lesson planning is a teacher's detailed description of the course of instruction or learning trajectory for lesson. A daily lesson plan is developed by teacher to guide class learning. Topic learning outcome shall be tabulated based on blooms taxonomy.

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Mechanical Engineering

COURSE EXECUTION SUMMARY 2019-20

Staff Name: Balaraj V	**Course Type: Core**	**Sem / Sec: 6th A**
Course Name: FINITE ELEMENT ANALYSIS	**Course Code: 17ME61 / 17C309**	**Total No. of Lecture Hours: 52**
Max marks: 60	**Prerequisites:** ENGG MATHS (15ME31/41) AND MECHANICS OF MATERIALS (15ME34)	

Sl. No.	Date	Time/Period	Topic covered	Remarks
01	12-02-2020	IV	Review mechanics and Matrices: Engineering applications of FEM, Equilibrium equation in elasticity, Conclusion. Strain-displacement relation for pane stress plane strain and 3-D.	
02	18-02-2020	V	Stress strain relations for plane stress & plane strain, problems on above topics, Conclusion. General description of FEM, Discretization process, Conclusion.	
03	19-02-2020	I	Types of elements 1D, 2D, & 3D elements, Size of elements, Location of nodes, Node numbering scheme, Half band width, Properties of stiffness matrix Conclusion.	
04	20-02-2020	III	Pre-processing, Post processing, Stiffness matrix of bar element by direct method, Review, Boundary conditions, Initial conditions, Euler's Lagrange's equations of Bar &Beams, Principle of Virtual Work. Conclusion.	
05	24-02-2020	III	Principle of minimum P.E, Problems Conclusion.	
06	25-02-2020	V	Review, Rayleigh – Ritz method &Galerkin's method.	
07	02-03-2020	III	Problems on Rayleigh – Ritz method	
08	03-03-2020	IV	Problems on Galerkin's method.	
09	03-03-2020	II	More problems on above methods	
10	04-03-2020	I	Linear interpolation polynomials in terms of global, natural and local, co-ordinates of bar.	
11	04-03-2020	II	Shape functions and Nodal load vector, Strain displacement matrix for linear element.	
12	05-03-2020	III	Introduction to interpolation function, Simplex complex and multiplex elements, Selection of the order of the interpolation polynomial Conclusion	
13	05-03-2020	V	Review, Convergence requirements, 2D Pascal triangle, Conclusion.	
14	06-03-2020	III	Shape functions and Nodal load vector, Strain displacement matrix	
15	07-03-2020	III	CST elements-Shape functions in terms global, natural and local, co-ordinates of bar and Nodal load vector, Strain displacement matrix, Jacobian for triangular and rectangular element.	
16	09-03-2020	IV	Lagrange's interpolations, higher order one dimensional elements, shape functions Iso sub and Super parametric elements.	
17	09-03-2020	SPL 5-6 PM	Shape function of 2-D quadrilateral element-linear, quadric element (9 noded and 8 noded elements).	
18	11-03-2020	I	Numerical integration: 1, 2 and 3 gauge point for 1D , 2D cases	

			and Problems on numerical integration: 1, 2 and 3 gauge point for 1D case.	
19	11-03-2020	SPL5-6PM	Introduction to BC's, of elimination method & penalty method.	
20	12-03-2020	III	Problems on bars and stepped bars with point load for displacements, reactions and stresses by using penalty approach	
21	17-03-2020	V	Problems on bars and stepped bars with point load for displacements, reactions and stresses by using elimination approach.	
22	18-03-2020	I	Problems on uniform varying bars with point load and body force (density), and surface forces (Temperature effect on bars) and bars with gap for displacements, reactions and stresses by using elimination approach and penalty approach.	
23	19-03-2020	III	Problems on Stepped bars with point load and body force (density), and surface forces (Temperature effect on bars)	
24	23-03-2020	III	Bars with gap for displacements, reactions and stresses by using elimination approach and penalty approach.	
25	24-03-2020	V	Derivation of Element Stiffness Matrices.	
26	25-03-2020	I	Assumption, direction of cosines	
27	26-03-2020	III	Numerical problems on Trusses.	
28	28-03-2020	III	Review Module 2: Introduction to beam element and Hermit shape functions beam element.	
29	30-03-2020	III	Stiffness matrix and load vector of functions beam element.	
30	31-03-2020	V	Numerical problems of fixed beams, simply supported beams carrying concentrated load and UDL.	
31	01-04-2020	I	Numerical problems of cantilever beams carrying concentrated load and linearly varying loads.	
32	02-04-2020	III	Numerical problems of beams carrying concentrated, UDL and Couple.	
33	04-04-2020	III	Review of Torsional equations; understand finite element formulation of shaft.	
34	06-04-2020	III	Numerical problems of solid uniform and stepped bar of circular section subjected to torque.	
35	07-04-2020	IV	Numerical problems of composite step shaft consist of different sections and hallow subjected to torque.	
36	08-04-2020	V	Introduction to heat transfer, Steady state heat transfer.	
37	09-04-2020	I	Review, 1D heat conduction governing equation.	
38	11-04-2020	III	Review, Boundary conditions, One dimension element and Galerkin approach for heat conduction.	
39	13-04-2020	III	Heat flux boundary condition,1D heat transfer in thin fins	
40	15-04-2020	III	Problems on 1D heat conduction Galerkin approach with free end convection.	
41	16-04-2020	I	Problems on 1D heat convection and transfer in thin fins with and without insulation.	
42	21-04-2020	III	Problems on 1D heat conduction with internal heat generation.	
43	22-04-2020	V	Flow through a porous medium	
44	23-04-2020	I	Flow through pipes of uniform sections	
45	27-04-2020	III	Flow through pipes of stepped Sections.	

46	28-04-2020	III	Problems on porous medium	
47	29-04-2020	V	Problems on of uniform sections and stepped Sections.	
48	11-05-2020	I	Revive of Mechanical vibration; Formulation for point mass and Consistent element mass matrix of one dimensional bar element	
49	12-05-2020	III	Formulation for Consistent element mass matrix of truss element.	
50	13-05-2020	V	Formulation for Lumped mass matrix of bar element, truss element.	
51	14-05-2020	I	Problems Eigen vectors and Eigen values and natural frequency of vibration of a Bars.	
52	15-05-2020	III	Problems Eigen vectors and Eigen values and natural frequency of vibration of a cantilever Beams	

COURSE EVALUATION AND ASSESSMENT SCHEME-2015

	What		To Whom	When/ Where (Frequency in the course)	Max Marks	Evidence Collected
Direct Assessment Methods	CIE	Continuous Internal Evaluation	Students	Thrice(Average of the three will be computed)	30	Blue Books
		Assignment		One(During Semester)	10	Assignment Books
		Practical Assessment		Once	40	Practical evaluation
	SEE	Semester Final Examination		End of Course (Answering One of two questions from five Modules)	60	Result sheet
		Practical Examination		One question from lot	60	Result sheet
Indirect Assessment Methods	Students Feedback		Students	End of the course	-	Questionnaire
	Course Exit Survey					

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom's taxonomy)

COURSE COMMITTEE CC MECH RYMEC

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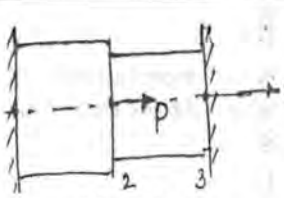
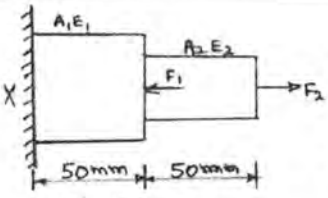
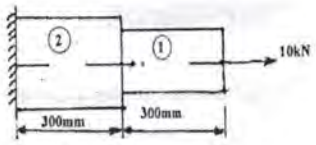
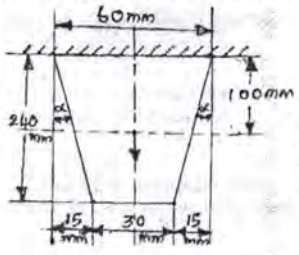
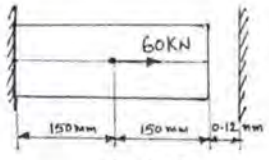
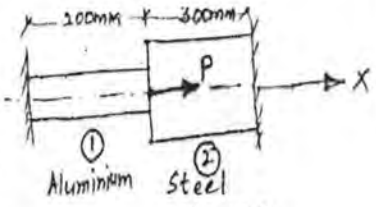
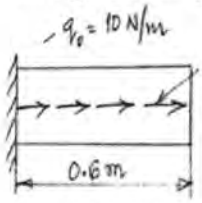
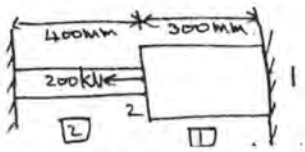
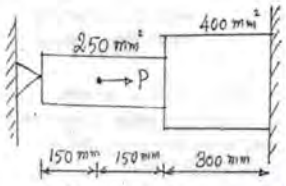
RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Mechanical Engineering

ASSIGNMENT - 01

Staff Name: BALARAJ V	Sec: A
Course Name: FINITE ELEMENT ANALYSIS(17ME61)	Total Contact Hours: 52

Q No	QUESTIONS	BTL	CO
Q1	What do you mean by FEM. List the different steps involved in solving a problem by FEM and its applications and state advantages of FEM & Disadvantages of FEM?	L1	1
Q2	Derive the equilibrium equations for 3-D Elastic body subjected to surface forces) 3-D Solid mechanic problem.	L3	1
Q3	Derive the stress-strain and strain stress relations for plane stress problem(2D elastic body) 2-D Solid mechanic problem.	L3	1
Q4	Write properties of stiffness matrix (K). Sketch & Explain Plain stress and Plain strain problems with suitable examples.	L1	1
Q5	What is symmetric banded matrix? With an example explain node numbering scheme and Half banded matrix.	L2	1
Q6	With sketch briefly explain following i) Types of elements ii) Size of the elements iii) Number of elements iv) Location of nodes	L2	1
Q7	Define coordinate system? What are different types of coordinate system used in FEM.	L1	2
Q8	Write the interpolation polynomial for Linear, Quadratic and cubic.	L1	2
Q9	Explain the convergence criteria with suitable examples and compatibility requirements in FEM.	L3	2
Q10	Consider the bar shown in the Fig.Q1. An axial load P=200 x10^3 E is applied as shown. Using penalty approach for handling boundary condition, do the following; a. Determine the nodal displacements. b. Determine the stress in each material. c. Determine the reaction forces. Take A_1=2400mm^2, A_2=600mm^2 E_1=70GPa, E_2=200GPa	L4	5
Q11	Using the direct stiffness method, determine the nodal displacements of stepped bar shown in figure Q2, A_1=150mm^2, A_2=100mm^2 E_1=200GPa, E_2=70GPa, F_1=10KN,F_2=5KN.	L4	5
Q12	Determine the nodal displacement and stresses in the element shown in fig. Q3, $_1$=500mm^2,A_2=2000mm^2,E_1=100GPa,E_2=200GPa, F_1=10KN,F_2=5KN.	L4	5

	 Fig.Q1.  Fig.Q2.  Fig.Q3.		
Q13	Solve for nodal displacements and elemental stresses for the following. Fig.Q.4. shows a thin plate of uniform lrnm thickness, Young's modulus E = 200 GPa, weight density of the plate = 76.6 x 10.6 N/mm^2. In addition to its weight, it is subjected to a point load of 1 kN at its midpoint and model the plate with 2 bar elements.	L4	5
Q14	Determine the displacements, reactions, and stresses for the Fig.Q.5. Using Penalty approach. Take E=210GPa, Area=250mm^2.	L4	5
Q15	An Axial load P=300KN is applied at 20°C to the rod as shown in the Fig.Q.6. the temperature then raised to 60°C. (i) Assemble the global stiffness matrix(K) and Global load vector(F).E_1=70x 10^9 N/m^2, E_2=200x 10^9 N/m^2,A_1=900mm^2, A_2=1200mm^2, α_1= 23x10^{-6}/°C, α_2= 23x10^{-6}/°C.  Fig.Q. 4  Fig.Q.5  Fig.Q.6	L4	5
Q16	Find the nodal displacement, stress and strain of the system shown in Fig.Q.7.Take E=70GPa , Area=1m^2.	L4	5
Q17	A stepped bar is shown in Fig.Q.8.Nodal displacement , nodal forces , stresses in each element and principal and shear stresses in each element. Take A_1=2400mm^2, A_2=600mm^2 , E_1=70GPa, E_2=200GPa.	L4	5
Q18	Determine the nodal displacements, element stresses, and support reactions of the axial loaded bar as shown in the Fig.Q.9. Use elimination method for handling boundary conditions. Take E=200GPa and Load P=300KN.  Fig.Q.7.  Fig.Q.8.  Fig.Q.9.	L4	5

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Department of Mechanical Engineering

CONTINUOUS INTERNAL EVALUATION-I (2019-20 Even Sem)

Staff Name: V. BALARAJ	**Semester: VI**	**Sec: A**
Course Name: FINITE ELEMENT ANALYSIS	**Course Code:17ME61**	**Date: 13 March 2020**
Max marks: 50	**Time : 9:15 to 10:45 PM**	

Q No	Answer any FIVE of the following and Draw neat sketches where ever necessary.	Mark	BTL	CO
Q1	What do you mean by FEM. List the different steps involved in solving a problem by FEM .	10	L2	1
	OR			
Q2	With neat sketches explain different types of elements.	10	L2	1
Q3	Derive the equilibrium equations for 3-D Elastic body subjected to surface forces.	10	L3	2
	OR			
Q4	Sketch & Explain Plain stress and Plain strain problems with suitable examples.	10	L2	2
Q5	Write a note on convergence criteria and Explain its requirements.	10	L2	1
	OR			
Q6	With sketch briefly explain following Boundary conditions of i) Structural Boundary conditions ii) Fluid flow Boundary conditions iii) Heat transfer Boundary conditions.	10	L2	1
Q7	Using the direct stiffness method, Evaluate the nodal displacements and Stresses of stepped bar shown in Fig.Q.7. A_1=150mm^2, A_2=100mm^2, E_1=200GPa, E_2=70GPa, F_1=10KN, F_2=5KN.	10	L4	CO 5
	OR			
Q8	Evaluate the displacements and stresses for the Fig.8. Using Penalty approach. Take E=210GPa, Area=250mm^2.			

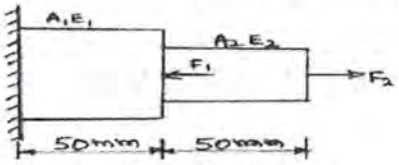

Fig .Q.7

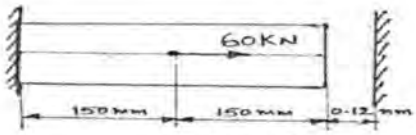

Fig .Q. 8

Q9	Solve for nodal displacements and Evaluate elemental stresses for the following. Fig.9. Shows a thin plate of uniform 1 rnm thickness, Young's modulus E = 200 GPa, weight density of the plate = 76.6 x 10^{-6} N/mm^3. In addition to its weight, it is subjected to a point load of 100 N at its midpoint.	10	L4	CO 5
	OR			
Q10	An Axial load P=300KN is applied at 20 °C to the rod as shown in the Fig.Q.10. The temperature then raised to 60 °C. E_1=70x10^{9}N/m^2, E_2=200x10^9 N/m^2, A_1=900mm^2, A_2=1200mm^2, α_1= 23x10^{-6}/°C, α_2= 23x10^{-6}/°C. Determine the displacements, and Evaluate stresses.			

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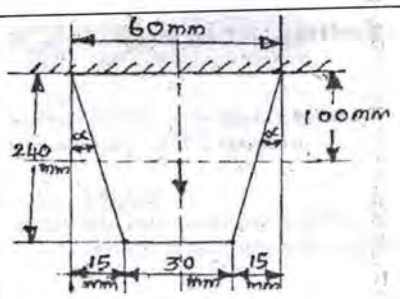


Fig.Q.9

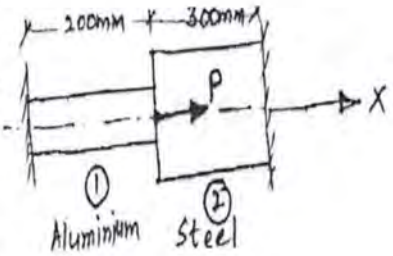
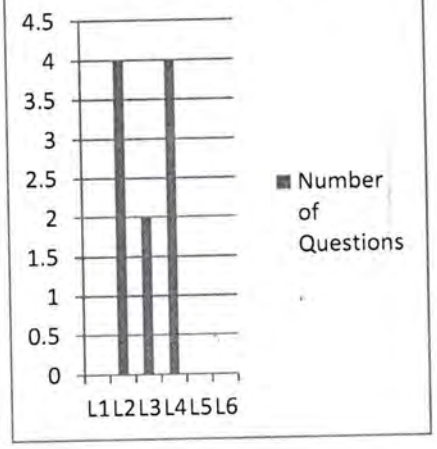
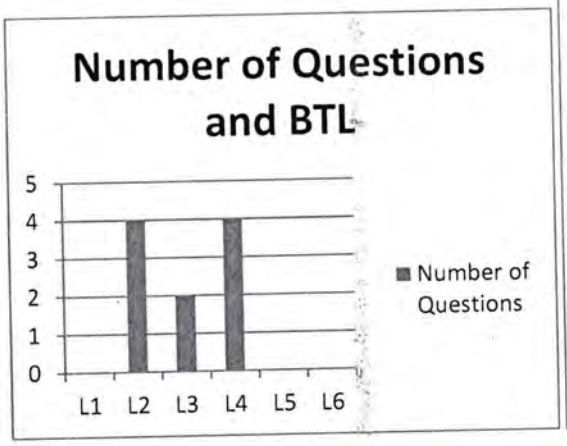
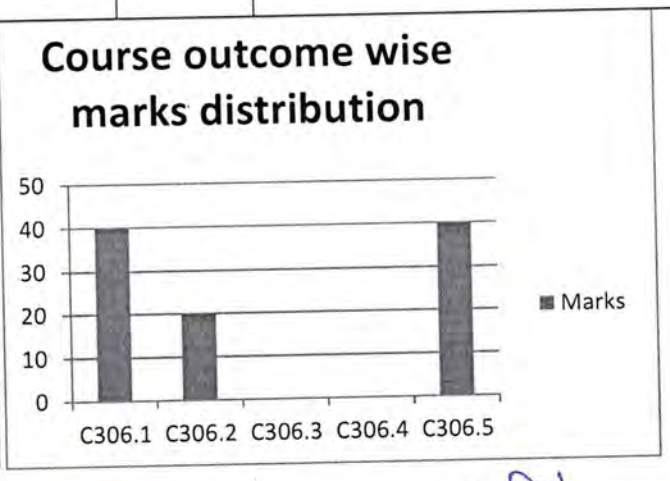


Fig.Q.10

COs	17C309.1	17C309.2	17C309.3	17C309.4	17C309.5
Number of Questions	4	2			4
Marks	40	20			40
BTL	L1	L2	L3	L4	L5
Marks		4	2	4	







Staff In charge | QP Coordinator | Course Coordinator | Head of Department

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RYM Engineering College,
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RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Mechanical Engineering

SCHEME OF EVALUATION FOR CIE-II (2019-20 Even Sem)

Staff Name: Balaraj V	**Sem:** VI	**Sec:** A
Course Name: FINITE ELEMENT ANALYSIS	**Course Code:** 17ME61	**Total Contact Hours:** 52
Max marks: 5X10=50	**Dates:** 13-March-2020	**Time:** 9:15 to 10:45 PM

No	SCHEME OF EVALUATION	Mark	BTL	CO	PO
Qa (1&2)	FEM Defination = 02 **marks** Steps involved in FEM:07*1= 07 **marks** Equilibrium equations = 01**marks**	10	L2	1	2
	Definition:03*02=06 **marks, (1-D, 2-D & 3-D)** Fig's: 02 **marks** Applications of each =02 **marks**	10	L2	1	1
Qb (3&4)	Sketch=02 **marks** Derivation = **05 marks** Three Equations=03 **marks**	10	L3	2	2&3
	Sketch both =**02 marks** plane stress def-**2 marks** plane strains def-**2 marks** Relation of plane stress with strain -**2 marks** Relation of plane strain with stress -**2 marks**	10	L1 &L 2	2	1&2
QC (5&6)	Graph with notations:02 **marks** Convergence criteria Explanation= **05 marks** Three requirements= 03 **marks**	10	L2	2	2
	Discus Homogeneous BC in structural: 02 **marks** Non homogeneous in structural BC in structural: 02 **marks** Heat transfer Boundary condition: 02 **marks** Fig's & Equations:04 **marks**	10	L2	3	2&3
Qd (7&8)	Elemental stiffness matrix: 02 **marks** Global Stiffness matrix and load vectors: 02 **marks** Writing the equilibrium equation: 02 **marks** Applying boundary condition and finding the Displacements, Stress :04 **marks**	10	L4	5	3&4
	Elemental stiffness matrix: 01 **marks** Global Stiffness matrix and load vectors: 02 **marks** Writing the equilibrium equation: 02 **marks** Finding **C**=01 **marks** Applying boundary condition and finding the Displacements, Stress :04 **marks**		L4	5	
Qd (9&10)	Elemental stiffness matrix=02 **marks** Global Stiffness matrix and load vectors=02 **marks** Load vectors due to body force=02, Nodal displacements=02 **marks** . Stress on each element=02 **marks**	10	L4	5	3&4

	Elemental stiffness matrix=02 **marks** Global Stiffness matrix and load vectors=02 **marks** Load vectors due to temperature=02 Nodal displacements=02 **marks** Stress on each element =02 **marks**		L4	5	3& 4

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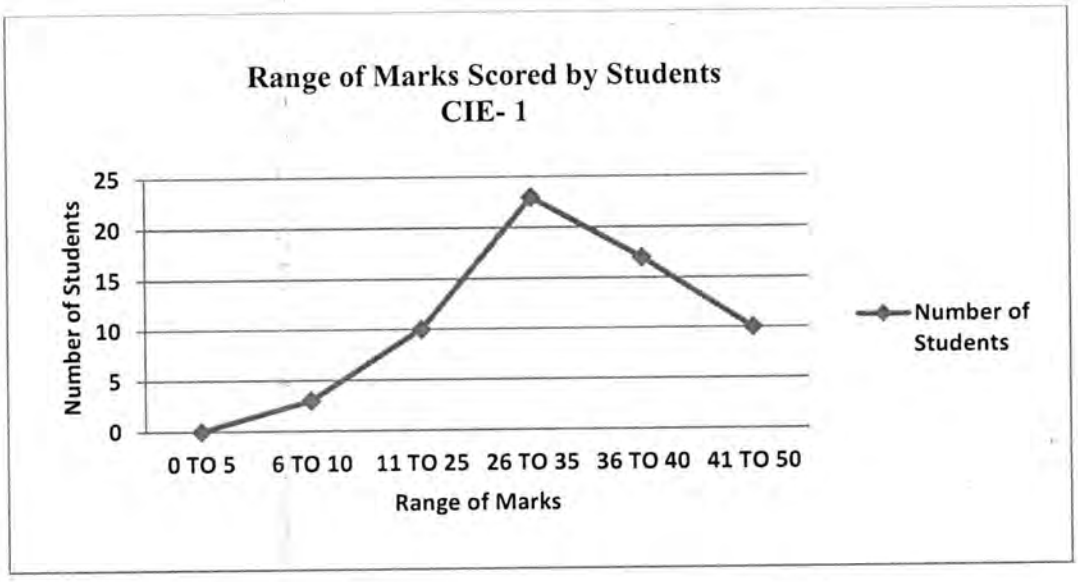
Department of Mechanical Engineering

CIE-I PERFORMANCE ANALYSIS

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
CO mapping	C309.1	C309.1	C309.2	C309.2	C309.1	C309.1	C309.5	C309.5	C309.5	C309.5
Max Marks /Question	10	10	10	10	10	10	10	10	10	10
Total marks of class /question	**411**	**106**	**354**	**120**	**181**	**80**	**91**	**342**	**157**	**213**
No. of students attended	**51**	**12**	**38**	**18**	**26**	**11**	**15**	**42**	**23**	**27**
No of students scored > 60% of marks/Question	**41**	**11**	**36**	**14**	**20**	**9**	**10**	**39**	**15**	**22**
Percentage of students scored > 60% of marks/Question	**80**	**92**	**95**	**77.8**	**77**	**82**	**67**	**93**	**65**	**81**

Mark range	0 TO 5	6 TO 10	11 TO 25	26 TO 35	36 TO 40	41 TO 50
No. Of Students	0	03	10	23	17	10



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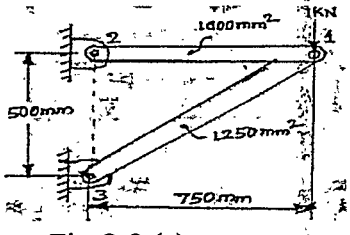
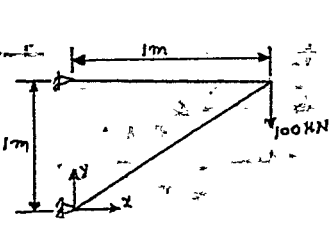
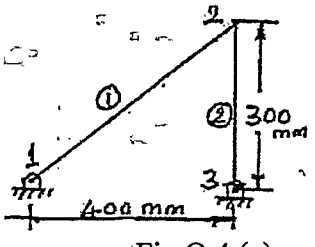
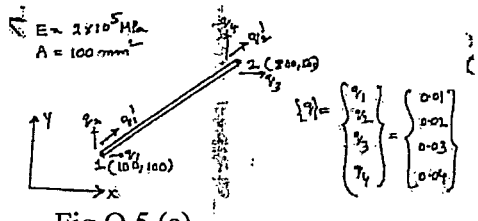
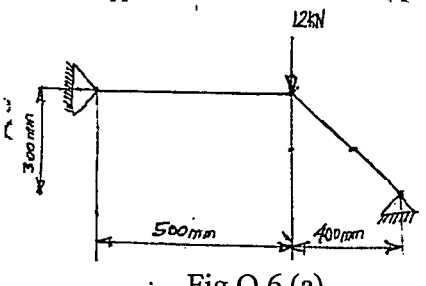
Department of Mechanical Engineering

ASSIGNMENT - 02

Staff Name: BALARAJ V	Sec: A
Course Name: FINITE ELEMENT ANALYSIS(17ME61)	Total Contact Hours: 50

Q No.	QUESTIONS on Analysis of Truss (Model-2)	BTL	CO
Q1	Derive an expression for Stiffness matrix for 2-D truss element.	L3	4
Q2	For the pin-jointed configuration shown in Fig.Q.2 (a), formulate the stiffness matrix. Also determine the nodal displacements, stress on each element and reaction at the supports. Take E1=E2=200GPa.	L4	3
Q3	For the two-bar truss shown in Fig. Q3 (a), determine the nodal displacements and stress through FEM. Take E = 210 GPa ; A = 0.01m^2	L4	4
Q4	Determine the nodal displacements and stress for truss shown in Fig.Q.4(a) Take $A_1=A_2=1500mm^2$; E = 210GPa.  Fig.Q.2 (a)  Fig.Q.3 (a)  Fig.Q.4 (a)	L4	4
Q5	Consider truss element shown in the Fig.Q.5 (a) X Y components of the coordinates of the two nodes are indicated in the Fig $\{q\}^T=[0.01\ 0.02\ 0.03\ 0.04]$ determine following. i) Local nodal displacements (q^1_1 and q^1_2) ii) Stress in each element iii) Global Stiffness matrix iv) Strain energy in the element. Take E= 2x10^5 Mpa ; A=100mm^2.	L3	3
Q6	For the Two Bar truss shown in the Fig.Q.6 (a) Determine the Nodal displacements and stress in each element and reaction at the support. Take E=2x10^{5}Mpa and A=200mm^2	L3	3
Q7 &8	For the two bars truss shown in the Fig.Q.7 (a) determine the nodal displacements and element stresses. A force of P= 1000KN is applied at node 1. Take E=200GPa and A=600mm^2 for each element. **For Fig.Q.8 (a) E=200GPa, A=6x10^{-6}m^2**  Fig.Q.5 (a)  Fig.Q.6 (a)	L4	4

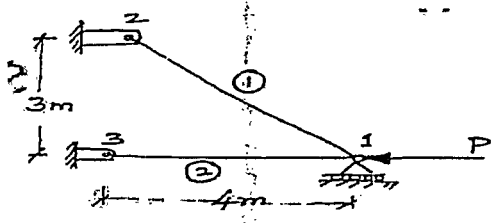


Fig.Q.8 (a)

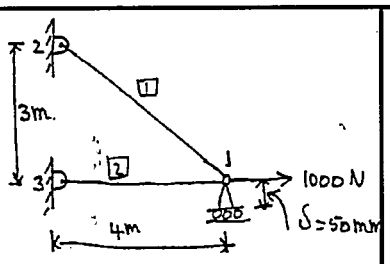


Fig.Q.7 (a)

Q No	QUESTIONS on Beams (Model-3)	BTL	CO
Q9	Derive Hermit shape functions of beam element (all 4 H_1, H_2, H_3 and H_4)?	L3	4
Q10	For the beam and loading shown in Fig.Q.10(a), determine: i) Slopes at 2 and 3 ii) The vertical deflection at the midpoint of the distributed load.	L4	4
Q11	A uniform cross sectional beam is fixed at one end and supported by a roller at the other end. A concentrated load 20kN is applied at the mid length of the beam as shown in Fig.Q.11 (a)	L4	4
Q12	A Continuous beam shown in Fig.Q.12 (a) is subjected to a point load at its free end. Model the beam into two elements and determine the deflection at its free end E = 210 GPa ; I=4x10^{6}mm^2.	L4	4
Q13	For the Beam shown in the Fig.Q.13 (a). Determine the mid span deflection. Take E= 200GPa, b=0.2m h=0.4m. Assume two element finite model	L4	4
Q14	For the beam element shown in the Fig.Q.14 (a). Determine the deflection under the given Load E=2x10^8 KN/m^2 and I=4x10^{-6} m^4.	L4	4
Q15	A simply supported beam of span 6m and uniform flexural rigidity EI=40000KN-m^2 is subjected to clockwise couple of 300KN-m at distance of 4m from the left end as shown in Fig.Q.17 (a). Find the deflection at midpoint of application of the couple and internal loads.	L4	4

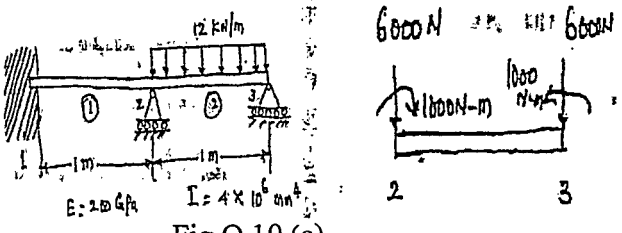


Fig.Q.10 (a)

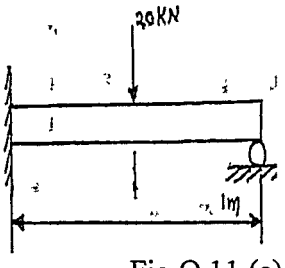
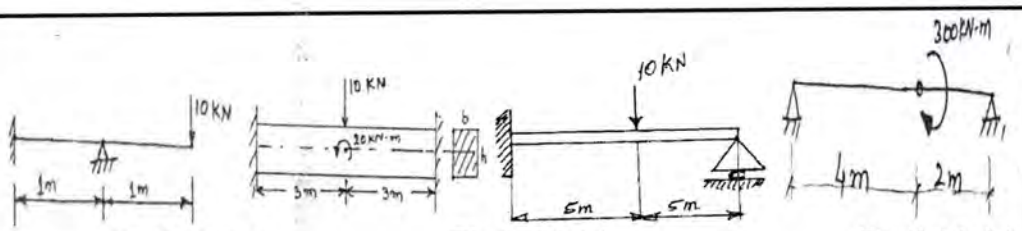


Fig.Q.11 (a)

	 Fig.Q.12 (a) Fig.Q.15 (a). Fig.Q.13 (a) Fig.Q.14 (a)		
Q16	Explain Geometric invariance (or Spatial isotropy) Pascal's triangle.	L2	2
Q17	Explain the Simplex elements, Complex elements and Multiplex elements.	L2	2
Q18	Explain the following (i) Size of elements (ii) Location of nodes (iii) Number of elements.	L2	2

Note: BTL (Blooms Taxonomy Level) CO (Course Outcome)

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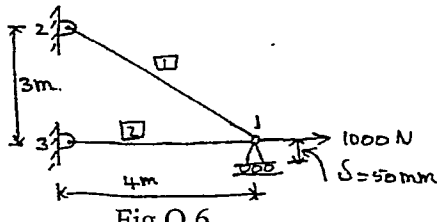
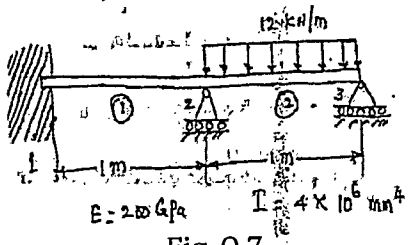
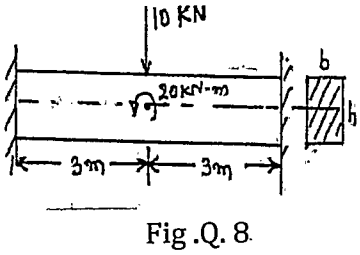
Department of Mechanical Engineering

CONTINUOUS INTERNAL EVALUATION- II (2019-20 Even Sem)

Staff Name: V. BALARAJ	**Semester: VI**	**Sec: A**
Course Name: FINITE ELEMENT ANALYSIS	**Course Code:17ME61**	**Date: 18 April 2020**
Max marks: 50	**Time : 9:30 to 11:00 PM**	

Q No	Answer any FIVE of the following and Draw neat sketches where ever necessary.	Marks	BTL	CO
Q1	Derive an expression for Stiffness matrix for 2-D truss element with suitable assumptions.	10	L3	4
	OR			
Q2	Derive Hermit shape functions of beam element (all 4 H_1, H_2, H_3 and H_4) and Draw variation shape curves?	10	L3	4
Q3	Explain Geometric invariance (or Spatial isotropy) Pascal's triangle.	10	L2	2
	OR			
Q4	Sketch & Explain the Simplex elements, Complex elements and Multiplex elements.	10	L2	2
Q5	Determine the nodal displacements and stress for truss shown in Fig.Q.5.Take $A_1=A_2=1500mm^2$; E = 210GPa.	10	L4	5
	OR			
Q6	For the two bars truss shown in the Fig.Q.6. Determine the nodal displacements and element stresses. A force of P= 1000KN is applied at node 1. Take E=200GPa and A=$6x10^{-6}$ $m^2$for each element.	10	L4	5
	 Fig.Q.5.  Fig.Q.6.			
Q7	For the beam and loading shown in Fig.Q.7. Determine: i) Slopes at 2 and 3 ii) The vertical deflection at the midpoint of the distributed load.	10	L4	5
	OR			
Q8	For the Beam shown in the Fig.Q.8. Determine the mid span deflection. Take E= 200GPa, b=0.2m h=0.4m. Assume two element finite model			
	 Fig .Q.7  Fig .Q. 8			
Q9	A solid stepped bar of circular cross section shown in Fig.Q.9. is subjected to a torque of 1kN-m at its free end and a torque of 3kN-m at its change in cross section. Determine the angle of twist and shear stresses in a bar. Take 2x105 N/mm2 and G=7x 104 N/mm2.	10	L4	5
	OR			
Q10	A Bar of circular cross section having a diameter of 50mm is firmly fixed at its ends and subjected to a torque at B and C as shown in Fig.Q.10. Determine			

maximum angle of twist and shear stresses. Take G=7x104N/mm2 and E=2x105 N/mm2.

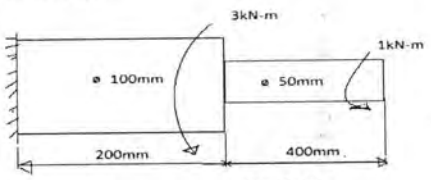


Fig.Q.9.

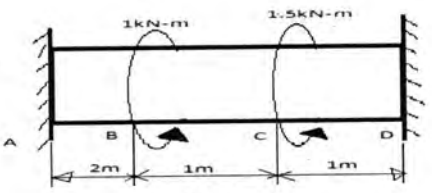


Fig.Q.10.

Note: BTL (Blooms taxonomy) **CO (course outcome) PO (program outcome)**

Staff **QP Coordinator** **Course Coordinator** **HOD**

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RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Mechanical Engineering

SCHEME OF EVALUATION FOR CIE-II (2019-20 Even Sem)

Staff Name: Balaraj V	**Sem:** VI	**Sec:** A
Course Name: FINITE ELEMENT ANALYSIS	**Course Code:**17ME61	**Total Contact Hours:** 52
Max marks: 5X10=50	**Dates:** 18-April-2020	**Time :** 9:30 to 11:00 PM

Q No	QUESTIONS	Marks	BTL	CO	PO
	Answer any Three of the following and Draw neat sketches where ever necessary.				
Qa	1. Fig with notations=02 **marks** Direction of cosines and Elemental length(l_e)=02 **marks** Strain energy and Elemental stiffness matrix for bar and conversion(local to global)=04 **marks** Equation for Elemental stiffness matrix for Truss=02 **marks**	10	L3	5	1& 2
	2. Sketch and B C's : 02 **marks** Hermit shape functions of beam element(H_1,H_2,H_3& H_3) : 06 **marks** Variation of shape function: 02**marks**	**10**	L4	5	2& 3
Qb	3. Pascal's triangle Flow Diagram:05 **marks** Geometric invariance Explaination:05 **marks**	**10**	L4	5	2
	4. Sketch :02 **marks** Explain the Simplex elements, Complex elements and Multiplex elements = 03*02= 06 **marks** Suitable Examples: 02 **marks**	**10**	L4	5	2& 3
QC	5. FEA Diagram wit all notations and Direction cosines Table(l, m and l_e) : 2 **marks** Elemental stiffness matrix(two elementsK_1,K_2) : 2 **marks** Global Stiffness matrix and load vectors: 2 **marks** Nodal displacements(q_1) : 2 **marks** Stress in each element(σ_1&σ_2) : 2 **marks**	**10**	L4	5	2& 3
	6. FEA Diagram wit all notations and Direction cosines Table(l, m and l_e) : 2 **marks** Elemental stiffness matrix(two elementsK_1,K_2) : 2 **marks** Global Stiffness matrix and load vectors: 2 **marks** Nodal displacements(q_1) : 2 **marks** Stress in each element(σ_1&σ_2) : 2 **marks**	**10**	L4	5	2& 3
Qd	7. Sketch: 2 **marks**(FEA Model) Elemental stiffness matrix=02 **marks** Global Stiffness matrix and load vectors=04 **marks** Nodal displacements=02 **marks** Reaction at the support=02 **marks** Nodal displacements(q_1) : 2 **marks** Stress in each element(σ_1&σ_2) : 2 **marks**	**10**	L4	5	2& 3

	Sketch: 2 **marks**(FEA Model) Elemental stiffness matrix=02 **marks** Global Stiffness matrix and load vectors=04 **marks** Nodal displacements=02 **marks** Reaction at the support=02 **marks** Nodal displacements(q_1) : 2 **marks** Stress in each element(σ_1&σ_2) : 2 **marks**	**10**	L4	5	2& 3
Qe	Sketch: 1 **marks**(FEA Model) Elemental stiffness matrix=02 **marks** Global Stiffness matrix and load vectors=03 **marks** angle of twist =02 **marks** shear stresses in a bar =02 **marks**	**10**	L4	5	2& 3
	Sketch: 1 **marks**(FEA Model) Elemental stiffness matrix=02 **marks** Global Stiffness matrix and load vectors=03 **marks** angle of twist =02 **marks** shear stresses in a bar =02 **marks**	**10**	L4	5	2& 3

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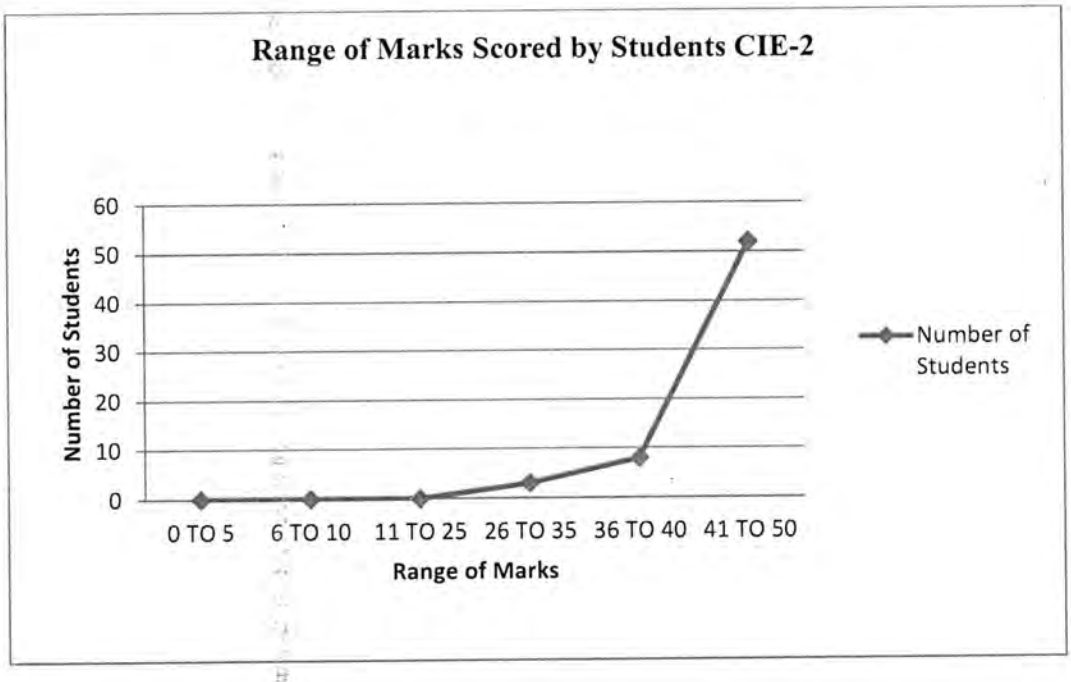
RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
Department of Mechanical Engineering

CIE-II PERFORMANCE ANALYSIS

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
CO mapping	C309.4	C309.4	C309.3	C309.2	C309.2	C309.5	C309.5	C309.5	C309.5	C309.5
Max Marks /Question	10	10	10	10	10	10	10	10	10	10
Total marks of class /question	**190**	**387**	**357**	**171**	**136**	**445**	**377**	**154**	**454**	**83**
No. of students attended	**21**	**44**	**41**	**21**	**15**	**49**	**42**	**17**	**50**	**9**
No of students scored > 60% of marks/Question	**21**	**44**	**41**	**21**	**15**	**49**	**42**	**17**	**49**	**9**
Percentage of students scored > 60% of marks/Question	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**98**	**100**

Mark range	0 TO 5	6 TO 10	11 TO 25	26 TO 35	36 TO 40	41 TO 50
No. Of Students	0	0	0	03	08	52



Staff In charge

Course Coordinator

COURSE COMMITTEE MECH RYMEC

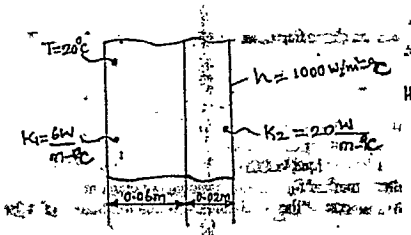
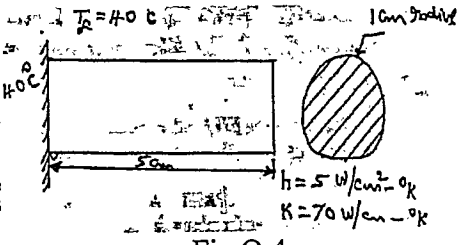
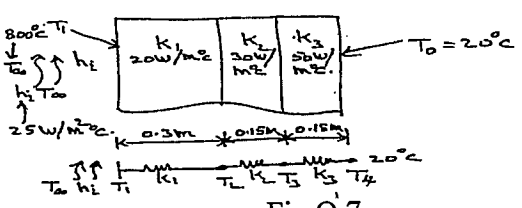
Head of Department
Head of the Department,
Mechanical Engineering Department
R.Y.M. Engineering College,
Cantonment, BELLARY-583 104

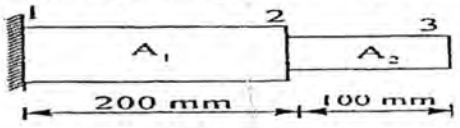
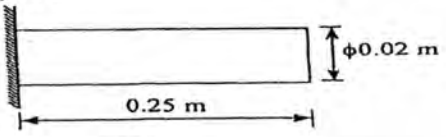
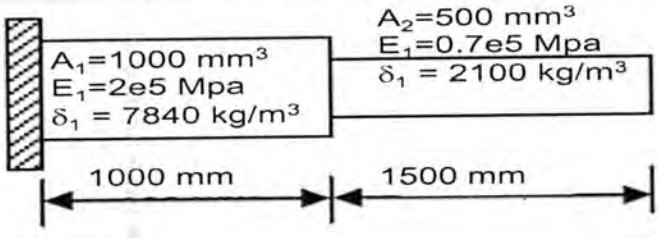
RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Mechanical Engineering

ASSIGNMENT - 03

Staff Name: BALARAJ V	**Sec: A**
Course Name: FINITE ELEMENT ANALYSIS(17ME61)	**Total Contact Hours: 50**

Q No	QUESTIONS (Model-4) Heat Transfer	BTL	CO
Q1	Explain boundary conditions in Thermal problems ((i) Specified Boundary conditions (ii)Specified heat flux (or insulated)boundary conditions(iii) Convective boundary conditions.	L2	4
Q2	Explain Galerkin's approach for heat conduction.	L2	4
Q3	Determine the temperature distribution through the composite wall, subjected to convection heat transfer on the right side surface, with convective heat transfer co-efficient shown in Fig.Q.3. The ambient temperature is -5°C.	L4	5
Q4	Find the temperature distribution in the I-D fin shown in Fig.Q.4 Take two elements fo FE idealisation.  Fig.Q.3.  Fig.Q.4	L4	5
Q5	The inner surface of the brick wall shown in Fig.Q.5. is at 28°C and outer surface is exposed to cold air at -15°C. The heat transfer coefficient at the outside surface is h=40W/m^2°C and thermal conductivity of material K=0.7 W/m°C. Determine the study state temperature distribution and heat flux through the wall. Use two elements.	L4	5
Q6	A composite wall consists of 3 materials shown in Fig.Q.6 . The outer temperature is T_o=20°C, determine the temperature distribution in the wall. Convection heat transfer takes place at inner surface with T_∞=800°C. Take h=25w/m^2°C, area=1m^2.  Fig.Q.6.  Fig.Q.7.	L4	5
	QUESTIONS (Model-5) Dynamic Analysis		
Q7	Derive an expression for consistent element mass matrix of **1-D Bar** element and **CST element** with neat sketch.	L3	4

Q8	Evaluate Eigen vectors and Eigen values for the stepped bar shown in the Fig.8. Take E=200Gpa and specific weight 7850kg/m^3. Draw the mode shapes. Take A_1=400mm^2 and A_2=200mm^2.	L4	5
Q9	Evaluate Eigen value and Eigen vector of longitudinal vibration of the constrained uniform bar circular bar shown in Fig.9.take minimum two elements. Take E=210Gpa and specific weight 7860kg/m^3.  Fig.8.  Fig.9.	L4	5
Q10	Consider the axial vibration of the stepped bar shown in the Figure . Develop the global stiffness matrix, mass matrix and eigen values. specific weight($\rho_1$0r δ_1)=7840kg/m^3 for 1 and specific weight($\rho_2$or δ_2)= 2100 kg/m^3 for 2.  	L4	5

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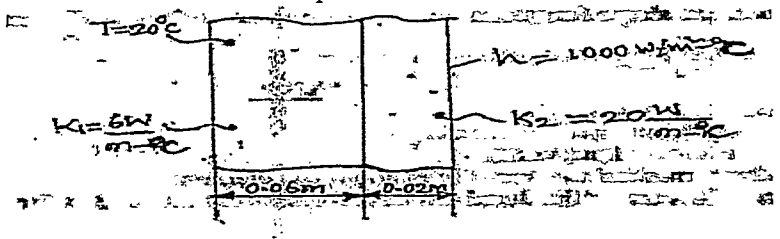
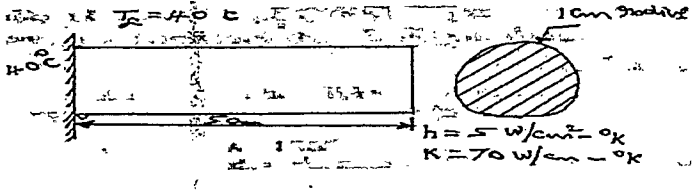
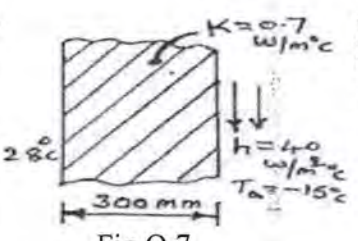
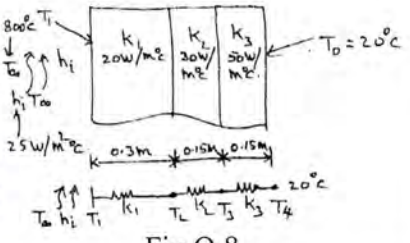
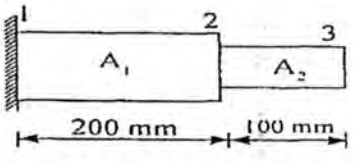
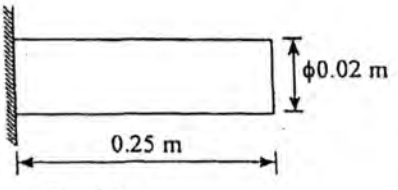
RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Mechanical Engineering

CONTINUOUS INTERNAL EVALUATION-III (2019-20 Even Sem)

Staff Name: Balaraj V	**Sem:** VI	**Sec:** A
Course Name: FINITE ELEMENT ANALYSIS	**Course Code:** 17ME61	**Total Contact Hours:** 50
Max marks: 5X10=50	**Dates:** 19-May-2020	**Time:** 09:45 am to 11:15am

Q No	QUESTIONS	Marks	BTL	CO	PO
	Note: Answer any THREE of the following and Draw neat sketches where ever necessary.				
Q1& Q2	Explain boundary conditions in Thermal problems ((i) Specified Boundary conditions (ii)Specified heat flux (or insulated)boundary conditions(iii) Convective boundary conditions. **Or** Explain Galerkin's approach for heat conduction.	10	L2	15C61.4	2
Q3& Q4	Derive an expression for consistent element mass matrix of **1-D Bar** element with neat sketch. **Or** Derive an expression for consistent element mass matrix of **CST element** with neat sketch.	10	L3	15C61.4	2
Q5& Q6	Determine the temperature distribution through the composite wall, subjected to convection heat transfer on the right side surface, with convective heat transfer co-efficient shown in Fig.Q.5. The ambient temperature is -5°C.  **Or** Find the temperature distribution in the I-D fin shown in Fig.Q.6 Take two elements fo FE idealisation. 	10	L4	15C61.5	3& 4
Q7& Q8	The inner surface of the brick wall shown in Fig.Q.5. is at 28°C and outer surface is exposed to cold air at -15°C. The heat transfer coefficient at the outside surface is h=40W/m^2°C and thermal conductivity of material K=0.7 W/m°C. Determine the study state temperature distribution and heat flux through the wall. Use two elements.	06	L4	15C61.5	3& 4

	Or A composite wall consists of 3 materials shown in Fig.Q.6 . The outer temperature is T_o=20°C, determine the temperature distribution in the wall. Convection heat transfer takes place at inner surface with T_∞=800°C. Take h=25w/m²°C, area=1m². .  Fig.Q.7.  Fig.Q.8.				
Q9& Q10	Evaluate Eigen vectors and Eigen values for the stepped bar shown in the Fig.8. Take E=200Gpa and specific weight 7850kg/m³. Draw the mode shapes. Take A1=400mm² and A2=200mm². **Or** Evaluate Eigen value and Eigen vector of longitudinal vibration of the constrained uniform bar circular bar shown in Fig.9.take minimum two elements. Take E=210Gpa and specific weight 7860kg/m³.  Fig.9.  Fig.10.	**10**	L4	15C61.5	3& 4

Note: BTL (Blooms Taxonomy Level) CO (Course Outcome)

Staff **QP Coordinator** **Course Coordinator** **HOD**

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RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Mechanical Engineering

SCHEME OF EVALUATION FOR CIE-III (2019-20 Even Sem)

Staff Name: Balaraj V	**Sem:** VI	**Sec:** B
Course Name: FINITE ELEMENT ANALYSIS	**Course Code:** 15ME61	**Total Contact Hours:** 52
Max marks: 5X6=30	**Dates:** 18-May-2019	**Time:** 08:15 am to 9:30am

Q No	QUESTIONS	Marks	BTL	CO	PO
	Note: Answer any THREE of the following and Draw neat sketches where ever necessary.				
Q1	Figures:02**marks** Equations:02**marks** Explanation of boundary conditions in Thermal problems ((i) Specified Boundary conditions:02**marks** (ii)Specified heat flux boundary conditions:02**marks** (iii) Convective boundary conditions:02**marks**	10	L2	4	2
Q2	Neat sketch :02**marks** Polynomial Equations:02**marks** Finding characteristics 02**marks** Explanation of Galerkin's approach for heat conduction:04**marks**	10	L2	4	2
Q3	Sketch: 01**marks** Finding characteristics: 02**marks** Derivation of the mass matrix for 1-D Bar element: 05 **marks** Variation plot curves: 02**marks.**	10	L3	4	2
Q4	Sketch: 01**marks** Finding characteristics: 02**marks** Derivation of the mass matrix for 2-D CST element: 05 **marks** Variation plot curves: 02**marks**	10	L3	4	2
Q5	Elemental stiffness matrix: 02 **marks** Global Stiffness matrix and load vectors: 03 **marks** Writing the equilibrium equation: 02 **marks** Applying boundary condition and finding the Temperature distributions 03 **marks**	10	L4	4	3& 4
Q6	Elemental stiffness matrix: 03 **marks** Global Stiffness matrix and load vectors: 02 **marks** Writing the equilibrium equation: 02 **marks** Applying boundary condition and finding the Temperature distributions 03 **marks**	10	L4	5	3& 4
Q7	Elemental stiffness matrix: 02 **marks** Global Stiffness matrix and load vectors: 03 **marks** Writing the equilibrium equation: 02 **marks** Applying boundary condition and finding the Temperature distributions 03 **marks**	10	L4	5	3& 4

Q8	Elemental stiffness matrix: 02 **marks** Global Stiffness matrix and load vectors: 03 **marks** Writing the equilibrium equation: 02 **marks** Applying boundary condition and finding the Temperature distributions 03 **marks**	**10**	L4	5	3& 4
Q9	Evaluate Eigen vectors: 04**marks** Eigen values for the stepped bar: 04**marks** Draw the mode shapes: 02**marks**	**10**	L4	5	3& 4
Q10	Elemental stiffness matrix: 02 **marks** Global Stiffness matrix and load vectors: 02 **marks** Writing the equilibrium equation: 02 **marks** Applying boundary condition and finding the mode shapes : 02 **marks** Draw the mode shapes: 02**marks**	**10**	L4	5	3& 4

Note: BTL (Blooms Taxonomy Level) CO (Course Outcome)

Staff **Course Coordinator** **HOD**

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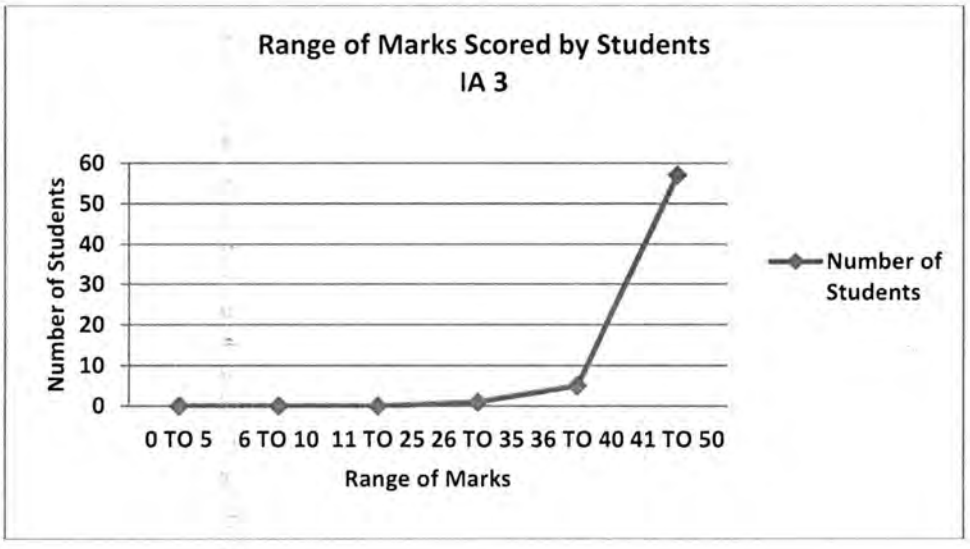
RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Mechanical Engineering

CIE-III PERFORMANCE ANALYSIS

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
CO mapping	C309.3	C309.3	C309.3	C309.3	C309.5	C309.5	C309.5	C309.5	C309.5	C309.5
Max Marks /Question	10	10	10	10	10	10	10	10	10	10
Total marks of class /question	**340**	**222**	**284**	**219**	**295**	**285**	**130**	**428**	**307**	**255**
No. of students attended	**39**	**24**	**31**	**26**	**32**	**32**	**15**	**47**	**33**	**27**
No of students scored > 60% of marks/Question	**39**	**24**	**31**	**26**	**31**	**32**	**15**	**47**	**33**	**27**
Percentage of students scored > 60% of marks/Question	**100**	**100**	**100**	**100**	**97**	**100**	**100**	**100**	**100**	**100**

Mark range	0 TO 5	6 TO 10	11 TO 25	26 TO 35	36 TO 40	41 TO 50
No. Of Students	0	0	0	01	05	57



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Department of Mechanical Engineering

REMEDIAL AND TUTORIAL CLASSES INFORMATION

Sl. No	Topic Covered
01	Typical Numericals & Numericals appeared in previous years university examination on Static force analysis of four bar mechanism and Slider-crank mechanism with and without friction.
02	Numerical problems on Dynamic force analysis of four-bar mechanism and Slider crank mechanism without friction.
03	Typical Numericals & Numericals appeared in previous years university examination on balancing of several rotating masses by balancing masses in same plane and in different planes.
04	Numericals appeared in previous years university examination onSingle cylinder engine, balancing in multi cylinder-inline engine
05	Reviwe of types of governors and force analysis of Porter and Hartnell governors.
06	Reviwe effect of gyroscopic couple on plane disc, aeroplane, ship, stability of two wheelers and four wheelers
07	Typical Numericals & Numericals appeared in previous years university examination on Principle of super position applied to SHM
08	Determination of Natural frequencies of simple systems by Newton's, Energy & Rayleigh's methods,Effect of mass of spring and problems
09	Numerical problems on over, critical and under damped systems and Logarithmic decrement
10	Review of analysis of forced vibration with constant harmonic excitation, Magnification factor (M.F.), Vibration isolation - Transmissibility ratio, Excitation of support

Staff

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RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
Department of Mechanical Engineering

FINAL CIE AND SEE MARKS

SI	USN	Name of the Student	CIE	SEE	SI	USN	Name of the Student	CIE	SEE
1	3VC16ME007	ABHISHEK SINHA	37	19	33	3VC17ME049	PAVAN KUMAR B	44	29
2	3VC17ME001	AJAY REDDY N	48	32	34	3VC17ME054	PAVITHRA R	50	31
3	3VC17ME002	AKASHA GOUDA H	45	31	35	3VC17ME081	VINAY KUMAR S	37	21
4	3VC17ME003	ANIL KITTUR	45	32	36	3VC17ME425	S MUSHTAQ AHMED	42	28
5	3VC17ME004	BHARATHISHA A B	43	31	37	3VC18ME401	ANAND K R	50	32
6	3VC17ME005	BHARGHAV R	40	26	38	3VC18ME402	ANIL KUMAR V	38	27
7	3VC17ME006	C ESHWAR	45	28	39	3VC18ME411	H M UDAY KUMAR	40	27
8	3VC17ME007	DEEPAK PATIL S R	43	30	40	3VC18ME413	IMRAN ABDUL W B	42	24
9	3VC17ME008	DODDA BASAVA B	47	30	41	3VC18ME415	K VINAY KUMAR	42	27
10	3VC17ME009	DURJAYA K B	43	27	42	3VC18ME418	KIRAN KUMAR D	45	37
11	3VC17ME010	EARESH VARMA C	45	29	43	3VC18ME420	KUMAR K	38	27
12	3VC17ME012	ERANAGOUDA K M	39	32	44	3VC18ME423	MADHUSUDHAN B	47	30
13	3VC17ME014	G RANJITH	50	34	45	3VC18ME424	MAHANTESH H M	45	37
14	3VC17ME016	G S SREE HARSHA	38	26	46	3VC18ME425	MANIKANTA K	45	28
15	3VC17ME018	GANESH GOWDA M	50	35	47	3VC18ME431	MULLA ALTAF HUSSAIN	43	27
16	3VC17ME019	GANESH J	45	31	48	3VC18ME433	NISAR AHAMED K M	44	27
17	3VC17ME020	GURUSIDDANA GOUDA B	42	30	49	3VC18ME434	G PAVAN KALYAN	45	23
18	3VC17ME021	HAMPANNA	45	30	50	3VC18ME435	PAVITHRA K	48	35
19	3VC17ME022	HANUMESH	47	26	51	3VC18ME441	SAGAR MP	39	26
20	3VC17ME023	J M ABDUL KHADER BASHA	47	32	52	3VC18ME443	SAMPATH KUMAR Y M	47	29
21	3VC17ME024	JAGADEESH	47	30	53	3VC18ME444	SANTOSH G	34	27
22	3VC17ME025	JEFFREY SUJAN KUMAR K	42	22	54	3VC18ME446	K SHIVA KUMAR	43	22
23	3VC17ME027	K M PARIKSHITH	45	30	55	3VC18ME449	SHIVA SHANKAR ADUR	44	28
24	3VC17ME028	KAISARAHMED D	43	31	56	3VC18ME454	THIPPESWAMY B	40	26
25	3VC17ME029	KARTHIK KUMAR D	40	27	57	3VC18ME455	THIPPESWAMY R	45	25
26	3VC17ME030	KARTHIK R B	45	34	58	3VC18ME457	V SIDDHI VINAYAKA	43	26
27	3VC17ME031	KIRAN MATH	47	34	59	3VC18ME459	VINOD KUMAR B	42	25
28	3VC17ME032	LOKESHA NAIK	48	32	60	3VC18ME460	VISHWANATH H	39	31
29	3VC17ME033	M CHAITANYA	50	32	61	3VC18ME461	VISHWANATH GOWDA K	43	21
30	3VC17ME041	MOHAMMED AZAM J	42	25	62	3VC18ME462	VYSHNAVI	49	26
31	3VC17ME043	MOHAN E	37	23	63	3VC18ME464	YESHWANTH D	29	24
32	3VC17ME046	NAVEEN SURAGOUNI	40	28					

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RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Mechanical Engineering

COURSE EXIT SURVEY

Staff Name: Balaraj V	**Semester: VI**	**Sec: A**
Course Name: Finite element analysis	**Course Code: 17ME61**	**Total contact hours: 52**
Max marks:60	**Prerequisites:** ENGG MATHS (17ME31/41) AND MECHANICS OF MATERIALS (17ME34)	
Academic year: 2019-20		

Course Code: 17C309	**Course Title: Finite element analysis**
Student Name: M. CHAITANYA	**USN:** 3VC17ME033
Mobile No.: 7892773306	**Email ID:** cmodlapur@gmail.com

Dear Student

In your opinion, how will you grade yourself in the attainment of the following Course Outcomes after undergoing **Industrial Safety** course (Please tick (√) in the appropriate column).

Excellent - 5, Very Good - 4, Good - 3, Average - 2, Below Average - 1

Course Outcome		5	4	3	2	1
At the end of the course, students will be able to ….						
17C309.1	Understand the concepts behind formulation methods in FEM.	✓				
17C309.2	Identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.			✓		
17C309.3	Develop element characteristic equation and generate global equation.		✓			
17C309.4	Apply suitable boundary conditions to a global equation for static and dynamic problems.		✓			
17C309.5	Evaluate displacements, stress and strains for different mechanical elements.	✓				

Chaitanya

Signature of Student

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Mechanical Engineering

COURSE SELF ASSESSMENT REPORT

Staff Name: : Balaraj V	**Semester: VI**	**Sec: A**
Course Name: Finite element analysis	**Course Code: 17C309**	**Total contact hours: 52**
Max marks:60	**Prerequisites:** ENGG MATHS (17ME31/41) AND MECHANICS OF MATERIALS (17ME34)	
Academic year: 2019-20		

Sl. No.	Questionnaires	Ratings				
		Excellent (5)	Very Good (4)	Good (3)	Fair (2)	Poor (1)
01	Rate your proficiency in understanding the concept of Engineering applications of finite element method , Boundary conditions and formulation of Finite element methods in different approaches.		✓			
02	Rate your proficiency in understanding Convergence criteria, Discretization process, types of elements, strain displacement relations, stress strain relations and Interpolation models.		✓			
03	Rate your proficiency in Analysis of Linear and Higher order interpolation functions and shape functions of 1D(linear, Quadratic),2D(CST ,Tetrahedral Element (TET 4),Eight-Nodded Hexahedral Element (HEXA 8) and 2D isoperimetric element).	✓	✓			
04	Rate your proficiency in understanding Gaussian quadrature one point, two point formulae, 2D integrals and Analysis of displacement, stress , strain in 1D bar, trusses using elimination and penalty approach.		✓			
05	Rate your proficiency in understanding Boundary conditions, Load vector, Hermite shape functions, Beam stiffness matrix and analysis of Beam with different loads and end conditions.		✓			
06	Rate your proficiency in understanding Finite element formulation of shafts and Finite element formulation of shafts.		✓			
07	Rate your proficiency in understanding Basic equations of heat transfer: Energy balance equation, Rate equation: conduction, convection, radiation, energy generated in solid, energy stored in solid and		✓			

08	Rate your proficiency in understanding 1D finite element formulation 1D bar element using vibration method and analysis of composite sections, straight fins with effect of temperature gradient , heat fluxes and heat transfer			✓		
09	Rate your proficiency in understanding Axi-symmetric Solid Elements and Numerical solution of Axisymmetric triangular element(s) subjected to surface forces, point loads, angular velocity, pressure vessels.	✓				
10	Rate your proficiency in understanding Formulation for point mass and distributed masses, Consistent element mass matrix of one dimensional bar element, truss element, Axisymmetric triangular element, quadrilateral element, beam element and evaluate Eigen values and Eigen vectors with Applications to bars and beams.	✓				

Naveen

Signature of Student

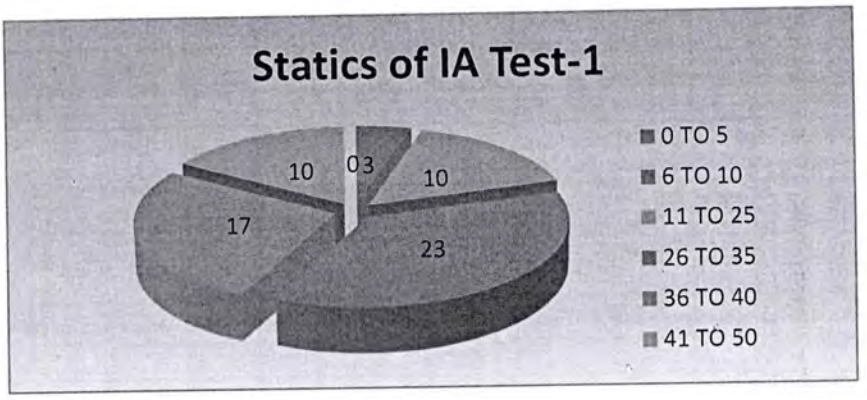
RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
Department of Mechanical Engineering

FINAL RESULT ANALYSIS

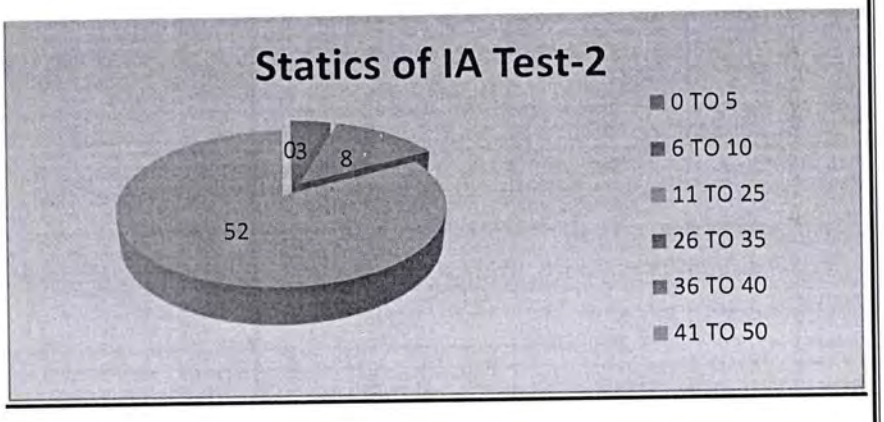
Result analysis has been done w.r.t **CIE** and **SEE** for the academic year 2019-2020.

STATISTICS OF CONTINUOUS INTERNAL EVALUATION

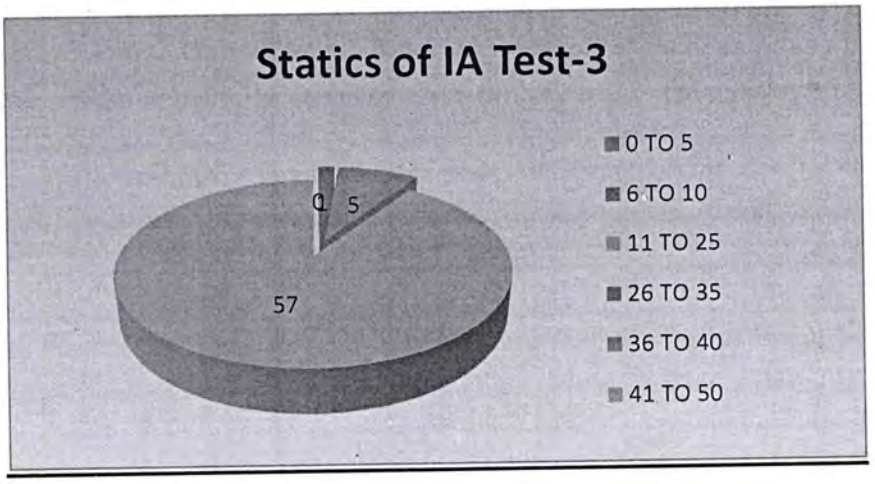
CIE - 1		No. of Students
Marks Range	0 TO 5	0
	6 TO 10	03
	11 TO 25	10
	26 TO 35	23
	36 TO 40	17
	41 TO 50	10
Total Number of Students		63



CIE - 1		No. of Students
Marks Range	0 TO 5	0
	6 TO 10	0
	11 TO 25	0
	26 TO 35	03
	36 TO 40	08
	41 TO 50	52
Total Number of Students		63



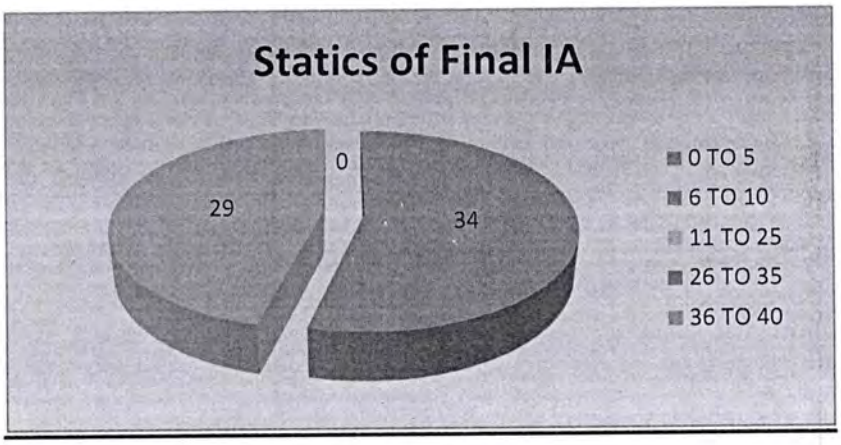
CIE - 1		No. of Students
Marks Range	0 TO 5	0
	6 TO 10	0
	11 TO 25	0
	26 TO 35	01
	36 TO 40	05
	41 TO 50	57
Total Number of Students		63



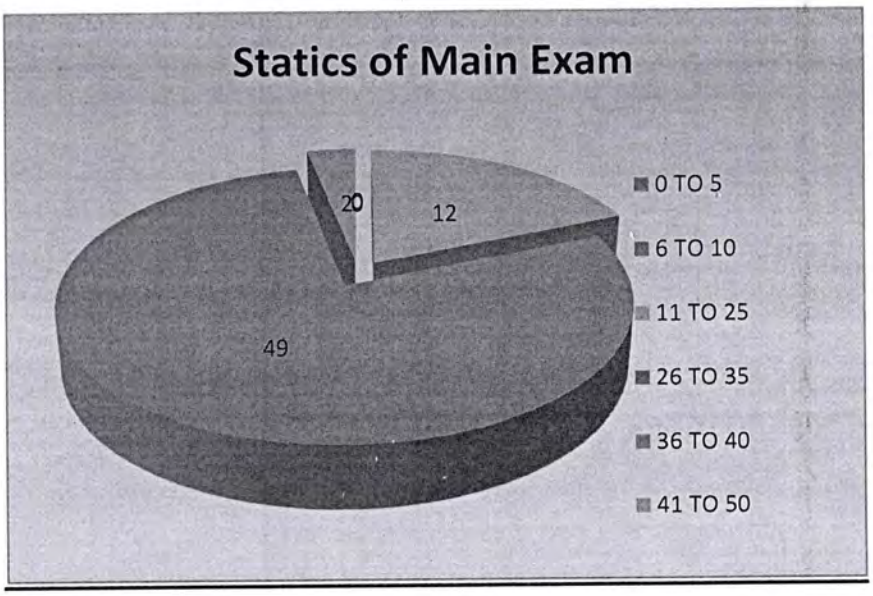
Head of the Department,
Mechanical Engineering Department
R.Y.M. Engineering Collage,
Cantonment, BELLARY-583 104

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
Department of Mechanical Engineering

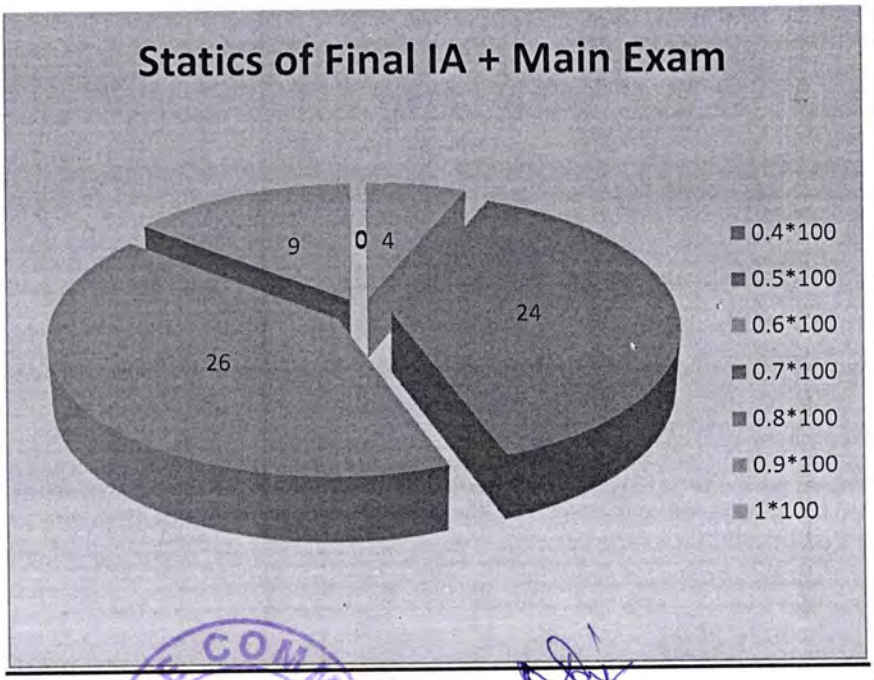
CIE - 1		No. of Students
Marks Range	0 TO 5	0
	6 TO 10	0
	11 TO 25	0
	26 TO 35	34
	36 TO 40	29
Total Number of Students		63



SEE		No. of Students
Marks Range	0 TO 5	0
	6 TO 10	0
	11 TO 25	12
	26 TO 35	49
	36 TO 40	02
	41 TO 50	0
Total Number of Students		63



Final CIE + SEE		No. of Students
Marks Range	0 TO 40	00
	41 TO 50	00
	51 TO 60	04
	61 TO 70	24
	71 TO 80	26
	81 TO 90	09
	91 TO 100	00
Total Number of Students		63



COURSE COMMITTEE CC MECH B.Y.M.E.C.

Head of the Department,
Mechanical Engineering Department.
B.Y.M. Engineering College,
Cantonment, BELLARY-583 104

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
Department of Mechanical Engineering

DIRECT & INDIRECT ATTAINMENT OF COs, POs, PSOs 2019-20

DIRECT CO ATTAINMENT GAP ANALYSIS 2019-20

Course Outcomes	CO Direct Attainment ={0.70(SEE)+0.30(CIE)}*100	CO Target	CO Attainment Gap
17C309.1	77.72	65	Nil
17C309.2	77.24	65	Nil
17C309.3	82.17	65	Nil
17C309.4	78.06	65	Nil
17C309.5	89.27	65	Nil

DIRECT & INDIRECT CO ATTAINMENT GAP ANALYSIS 2019-20

Course Outcomes	CO Direct & Indirect Attainment ={ Indirect Attainment (0.2) +Direct Attainment (0.8)}*100	CO Target	CO Attainment Gap
17C309.1	77.26	65	Nil
17C309.2	76.76	65	Nil
17C309.3	81.37	65	Nil
17C309.4	77.24	65	Nil
17C309.5	88.48	65	Nil

ACTION REPORT ON GAP ANALYSIS

Course Outcomes	Action proposed to bridge the gap	Modification of target if achieved
17C309.1	Set target is attained	Higher target will be set for next academic batch
17C309.2	Set target attained	Higher target will be set for next academic batch
17C309.3	Set target is attained	Higher target will be set for next academic batch
17C309.4	Set target is attained	Higher target will be set for next academic batch
17C309.5	Set target is attained	Higher target will be set for next academic batch

COURSE COMMITTEE CC MECH RYMEC

Head of the Department,
Mechanical Engineering Department
R.Y.M. Engineering College,
Cantonment, BELLARY-583 104

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
Department of Mechanical Engineering

INSTRUCTOR REPORT **Academic Year – 2019-20** **Sec: 'A'**

Impact of Delivery Methods (state the delivery methods used and its effectiveness):

- Delivery methods followed are chalk, marker, board & PPT.
- Chalk & Board is better mode of teaching to make the students to understand the equations, step by step derivations and problem solving by graphical and numerical methods.
- PPT is used to improve the effectiveness of teaching theory portion, time saving, to quote relevant examples with video content related to the topic and beyond syllabus.

Course Outcome Attainment Remarks :

Set targets are achieved for the current academic year and higher targets are set for the next academic batch.

Course Owner Feedback:

a) Instructor Feedback :

- FEA is one of the major technical subjects and at the higher level of core mechanical engg department which demands more detailed explanation with many examples and applications to make the students to follow the concepts with better clarity, hence this subject requires more time to cover the entire syllabus. I have applied the theory from books to real time situations and solved problems.

-

b) Scope for improvement:

- Scope to increase number of contact hours, practicing more number of numerical problem on each topic.
- Finite element analysis of structural, noise and vibration, fluid dynamics and can solve the projects related to it.
- In addition to subject also solve engineering problems by different CAE software uses in different fields like Structural, Thermal, Dynamics e.t.c.

COURSE COMMITTEE CC MECH RYMEC

Signature of Staff Member

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10ME64

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Finite Element Methods

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting at least TWO questions from each part.*
2. *No hand book required.*

PART – A

1 a. Explain the step-by-step procedure for the application of finite element method for structural problems. **(08 Marks)**

b. Derive the differential equations of equilibrium for a body subjected to a three dimensional stress system and body force. **(12 Marks)**

2 a. Derive the Euler-Lagrange's equation by considering the functional,

$$I = \int_{x_1}^{x_2} F(x, u, u', u'')dx$$

Also obtain the expressions for natural boundary conditions and essential boundary conditions. **(10 Marks)**

b. A system of springs is subjected to a force of 500 N as shown in Fig. Q2 (b). Determine the forces at points A and D, and displacement at points B and C. Apply the principle of minimum potential energy. **(10 Marks)**

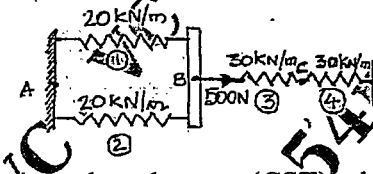

Fig. Q2 (b)

3 a. For a constant strain triangular element (CST), derive (i) Shape functions in natural coordinates and draw the sketches showing distributions of shape functions, and (ii) Jacobian matrix. **(14 Marks)**

b. Compute the shape functions N_1, N_2 and N_3 at point P(8, 7) for the constant strain triangular element shown in Fig. Q3 (b). **(06 Marks)**

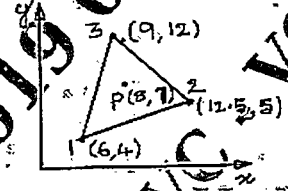

Fig. Q3 (b)

4 a. List three properties each of, (i) Shape functions and (ii) Stiffness matrix. **(06 Marks)**

b. A stepped bar with it's both ends fixed as shown in Fig. Q4 (b) is subjected to an increase in temperature of 50°C. Determine displacements and forces at points A, B, C and D. Take Young's moduli of steel, bronze, and aluminium as $E_S = 200$ GPa, $E_B = 83$ GPa and $E_{AL} = 70$ GPa respectively. The coefficients of thermal expansions are $\alpha_S = 12 \times 10^{-6}/°C$, $\alpha_B = 19 \times 10^{-6}/°C$ and $\alpha_{AL} = 22 \times 10^{-6}/°C$. **(14 Marks)**

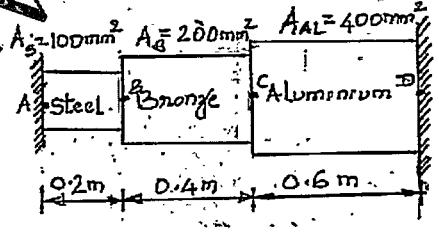

Fig. Q4 (b)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – B

5 a. Derive Lagrange shape functions for a bar element with cubic displacement distribution and show their distributions with neat sketches. **(12 Marks)**

b. Use two point Gaussian quadrature to evaluate the following integral:

$$I = \int_{-1}^{1}\int_{-1}^{1} (\xi^3 - 1)(\eta - 1)^2 \, d\xi d\eta .$$ **(08 Marks)**

6 a. Derive the expression for the stress induced in a truss member. Start from the expression for the stress (σ), which is a function of strain-displacement matrix, transformation matrix and displacement vector for the element. **(06 Marks)**

b. A truss is subjected to a force of 10 KN as shown in Fig. Q6 (b). Determine (i) Displacements and forces at points A, B and C (ii) Local forces on the member AB and (iii) Stress induced in the member BC. Take Young's modulus for the material of the truss as E = 210 GPa and cross sectional area of each truss member as $A = 600\ mm^2$. **(14 Marks)**

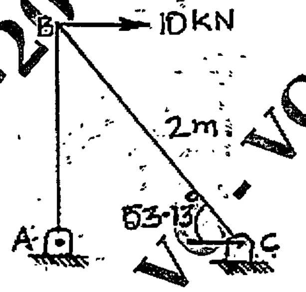

Fig. Q6 (b)

7 a. Derive the statically equivalent nodal force vector for a two noded beam element subjected uniformly distributed load (W). **(08 Marks)**

b. A beam with fixed end and roller support is subjected to a point force of 20 KN as shown in Fig. Q7 (b). Determine (i) Transverse forces and bending moments, and (ii) Deflections and slopes at points A, B and C. Take $E = 2 \times 10^8\ KN/m^2$ and $I = 8 \times 10^{-6}\ m^4$. **(12 Marks)**

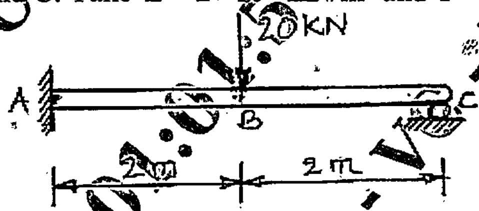

Fig. Q7 (b)

8 a. Explain the specified temperature and specified heat flux boundary conditions, with neat sketches. **(06 Marks)**

b. Determine the temperature distribution through the composite wall subjected to convection heat loss on the right side surface with convective heat transfer coefficient as shown in Fig. Q8 (b). The ambient temperature is $-5°C$.
Consider area (A) of the wall to be 1 m^2. **(14 Marks)**

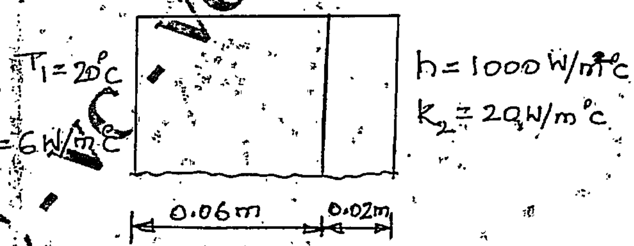

Fig. Q8 (b)

* * * * *

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CBCS Scheme

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15ME61

Sixth Semester B.E. Degree Examination, June/July 2018
Finite Element Analysis

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

VTU EXAMS JUNE-JULY 18 18/06/2018 08:34:33

Module-1

1 a. Define FEM. Discuss various applications of FEA in different domain. **(04 Marks)**

b. Explain convergence requirements of a displacement field. **(04 Marks)**

c. Using minimum potential energy determine the nodal displacement of a spring system shown in Fig. Q1(c). **(08 Marks)**

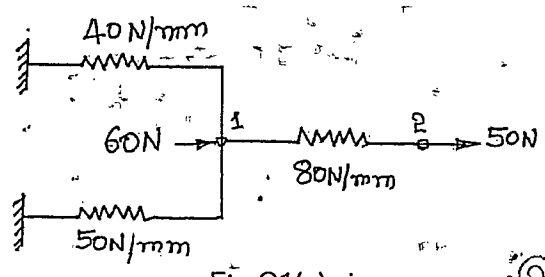

Fig.Q1(c)

OR

2 a. Using Rayleigh – Ritz method, determine the displacement at midpoint and stress variation in a one dimensional rod as shown in Fig.Q2(a). **(09 Marks)**

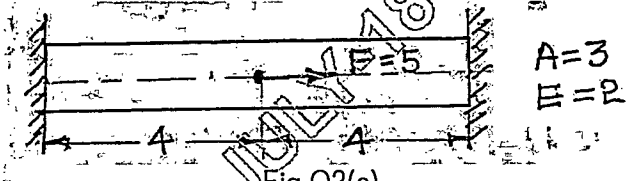

Fig.Q2(a)

b. Write stress-strain relations for plain stress and plain strain conditions. **(04 Marks)**

c. What do you mean by simplex, complex and multiplex elements? **(03 Marks)**

Module-2

3 a. What are higher order element? Derive shape function for 1D quadratic element in natural co-ordinates. **(06 Marks)**

b. Deduce expression for shape function for four noded tetrahedral element (TET4) using Lagrange interpolation functions. **(06 Marks)**

c. Evaluate $\int_{-1}^{+1} (x^2 + \sin\frac{\pi x}{2})\,dx$ using suitable Gauss points numerical integration. **(04 Marks)**

OR

4 a. For the stepped bar shown in Fig.Q4(a). Determine the nodal displacements, stress in each element and left support reaction. **(10 Marks)**

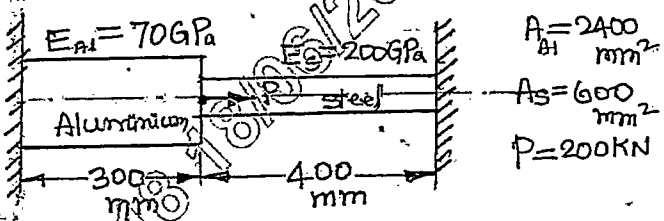

Fig.Q4(a)

b. With assumptions, deduce element stiffness matrix used for analysis of trusses. **(06 Marks)**

Module-3

5 a. Derive Hermite shape function for a beam element. **(08 Marks)**

b. For the beam and loading as shown in Fig.Q5(b), determine deflection, slope and support reaction. Take E = 110GPa, I = $5 \times 10^{-4} m^4$. **(08 Marks)**

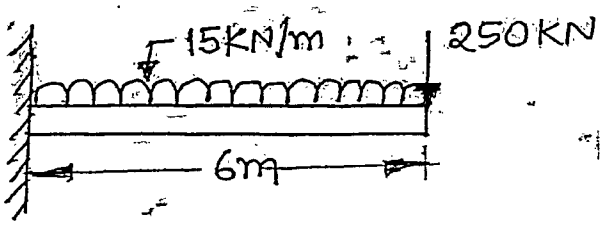

Fig.Q5(b)

OR

6 a. Derive torsional stiffness matrix for a circular shaft subjected to pure torsion. **(06 Marks)**

b. For the circulars stepped shaft shown in Fig.Q6(b) determine stresses and angle of twist. **(10 Marks)**

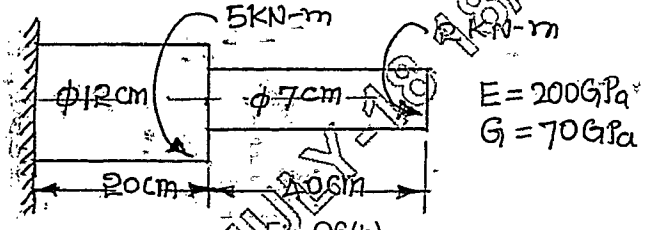

Fig.Q6(b)

Module-4

7 a. Briefly describe rate equations and boundary conditions in heat transfer analysis. **(06 Marks)**

b. Determine the temperature distribution through composite wall shown in Fig.Q7(b) when the convective heat loss occurs on the right surface. Take K_1 = 6W/m°C and K_2 = 20 W/m°C. **(10 Marks)**

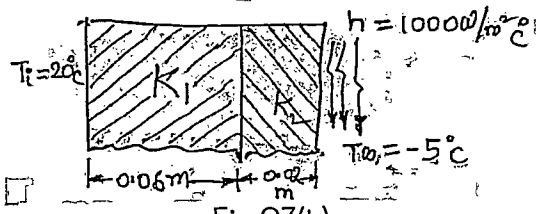

Fig.Q7(b)

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OR

8 a. Deduce the governing differential equation for one-dimensional fluid flow through a process medium. **(06 Marks)**

b. For the smooth pipe of variable c/s shown in Fig.Q8(b). Determine the potential at the junction the velocities in each section of pipe and the volumetric flow rate. The potential at the left end is $P_1 = 12m^2/S$ and that at right end is $P_4 = 3\ m^2/S$. Take $K_x = 1$. **(10 Marks)**

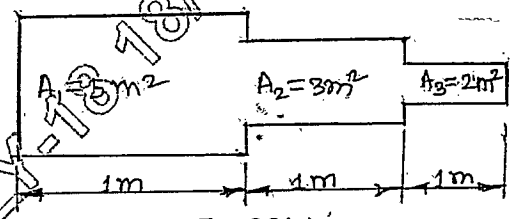

Fig.Q8(b)

Module-5

9 a. What is an axisymmetric element? Derive Jacobian matrix for axisymmetric triangular element. **(08 Marks)**

b. For the element of an axisymmetric body rotating with constant angular velocity W = 1000 rev/min as shown in Fig.Q9(b). Determine the body force vector including weight of material with specific density is 7850 kg/m^3. **(08 Marks)**

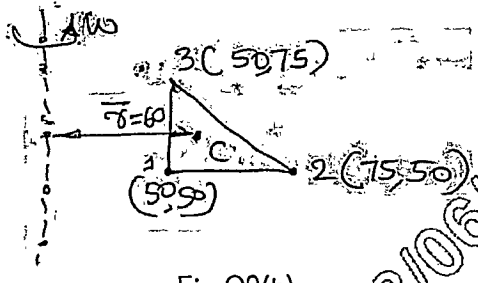

Fig.Q9(b)

OR

10 a. Derive an expression of element mass matrix for a bar element. **(06 Marks)**

b. For the stepped bar shown in Fig.Q10(b) determine the eigen values and eigen vector. Take $A_1 = 400mm^2$, $A_2 = 200mm^2$, $\rho = 7850\ kg/m^3$, $E = 200GPa$. **(10 Marks)**

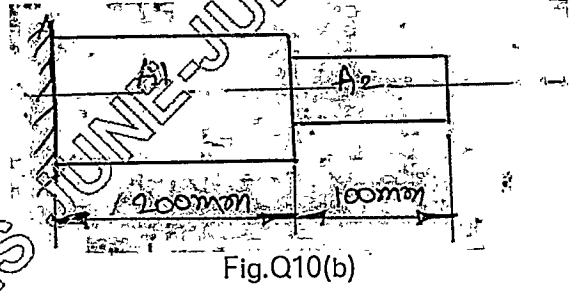

Fig.Q10(b)

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10ME64

Sixth Semester B.E. Degree Examination, June/July 2018
Finite Element Methods

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

VTU EXAMS JUNE-JULY-18 30/06/2018 08:46:49

PART – A

1 a. Write the equilibrium equations in elasticity subjected to body force. **(04 Marks)**

b. Describe the steps involved in FEM. **(08 Marks)**

c. Write a note on node numbering and half Band width. **(08 Marks)**

2 a. For the spring system shown in Fig. Q2 (a), using the principle of minimum potential energy. Determine the nodal displacement. **(10 Marks)**

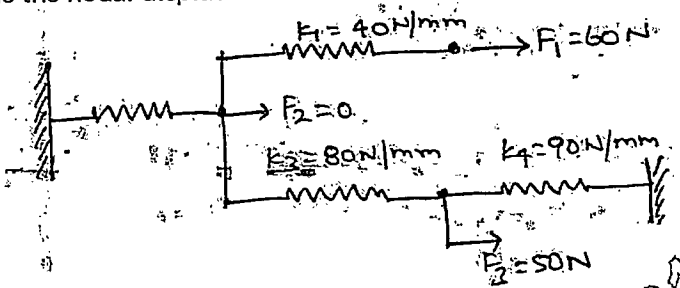


Fig. Q2 (a)

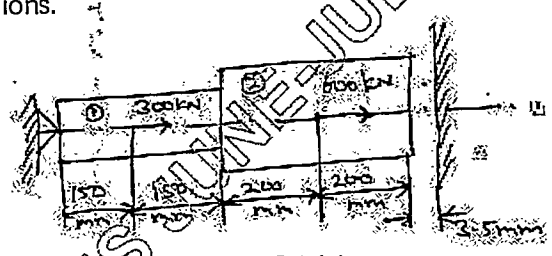
b. A simply supported beam of length 'L' is subjected to UDL of P_0 N/m. Determine the maximum deflection using Galerkin's method. **(10 Marks)**

3 a. Derive the shape functions of CST element in natural coordinate. **(10 Marks)**

b. What is the purpose of Pascal's triangle? Represent the 2D Pascal's triangle upto 5th order. **(05 Marks)**

c. Write a note on simplex, complex and multiplex elements. **(05 Marks)**

4 a. For the Bar shown in Fig. Q4 (a), determine the nodal displacement, element stresses and support reactions. **(12 Marks)**



$A_1 = 250\ mm^2$
$A_2 = 400\ mm^2$
$E_1 = E_2 = 200\ GPa$

Fig. Q4 (a)

b. Solve the following equations using Gauss-elimination technique.

$$5x_1 - 4x_2 + x_3 = 0$$
$$-4x_1 + 6x_2 - 4x_3 + x_4 = 1$$
$$x_1 - 4x_2 + 6x_3 - 4x_4 = 0$$
$$x_2 - 4x_3 + 5x_4 = 0$$

(08 Marks)

PART – B

5 a. Obtain the shape functions of 8-noded rectangular element in Lagrangian. **(08 Marks)**

b. Explain the following with neat sketches:-

(i) Iso-parametric element.

(ii) Sub-parametric element.

(iii) Super-parametric element. **(06 Marks)**

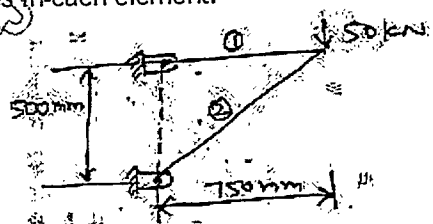
c. Find $I = \int_{-1}^{1} (a_0 + a_1\xi + a_2\xi^2 + a_3\xi^3)\,d\xi$. Use 2-point formula a's are constants. **(06 Marks)**

6 a. Derive the stiffness matrix for a truss element. **(10 Marks)**

b. A truss shown in Fig. Q6 (b), is made of 2 bars, determine

(i) Nodal displacement.

(ii) Stresses in each element. **(10 Marks)**



$E_1 = E_2 = 200$ GPa,
$A_1 = 1000$ mm^2
$A_2 = 1200$ mm^2

Fig. Q6 (b)

7 a. Derive the Hermite shape function for a beam element. **(12 Marks)**

b. A Cantilever beam subjected to point load of 250 KN as shown in Fig. Q7 (b). Determine deflection at tip and support reactions.

E = 200 GPa, I = 4×10^6 mm^4, $l_e = 0.8$m. **(08 Marks)**

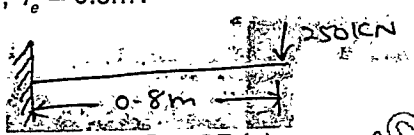


Fig. Q7 (b)

8 a. Calculate the temperature distribution in a 1-D fin with the physical properties given in Fig. Q8 (a). There is a uniform generation of heat inside the wall of $\dot{Q} = 400\,W/m^3$. **(10 Marks)**

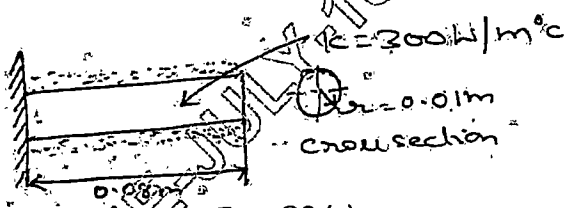


Fig . Q8 (a)

b. Determine the temperature distribution through the composite wall as shown in Fig. Q8 (b). Convection heat loss occurs on the right surface. Assume a unit area. **(10 Marks)**

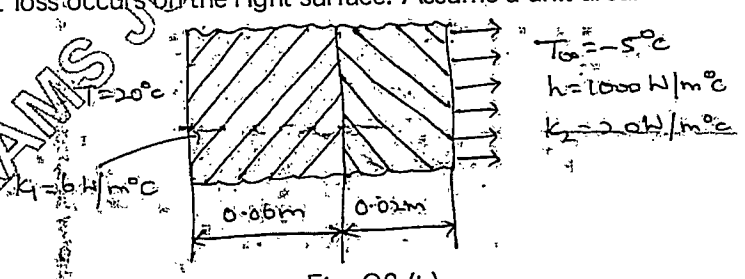


Fig. Q8 (b)

* * * * *

VTU EXAMS JUNE-JULY 18 30/06/2018 08:46:49

RAO BAHADUR Y MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF MECHANICAL ENGNEERING
DIRECT ATTAINMENT 2019-20

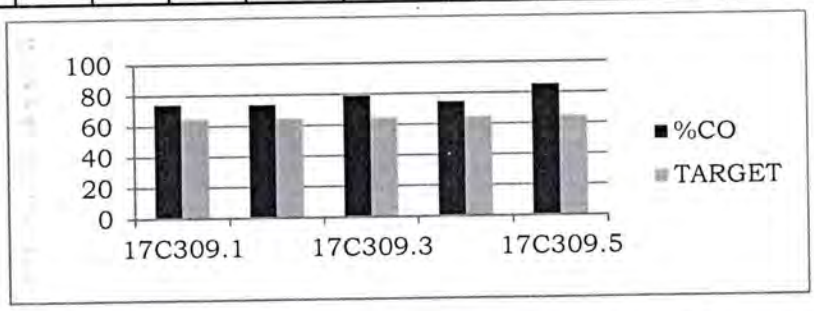
Faculty: Mr.V BALARAJ **Code:** 17C309
Subject: FINITE ELEMENT ANALYSIS
SEM: VI **SEC:** A

COURSE OUTCOME STATEMENT	
17C309.1	Understand the concepts behind formulation methods in FEM.
17C309.2	Identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.
17C309.3	Develop element characteristic equation and generate global equation.
17C309.4	Apply suitable boundary conditions to a global equation for static and dynamic problems .
17C309.5	Evaluate displacements, stress and strains for different mechanical elements.

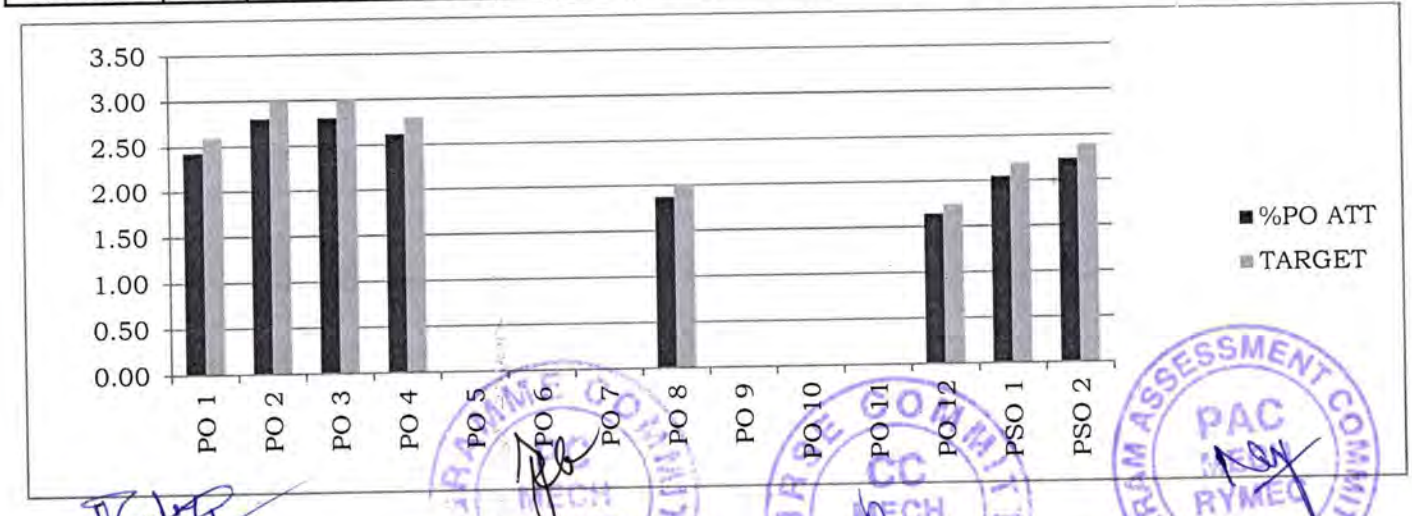
CO-PO/PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
17C309.1	2	3	3	2	0	0	0	2	0	0	0	0	3	2
17C309.2	2	3	3	3	0	0	0	2	0	0	0	1	2	3
17C309.3	3	3	3	3	0	0	0	2	0	0	0	2	2	2
17C309.4	3	3	3	3	0	0	0	2	0	0	0	2	1	2
17C309.5	3	3	3	3	0	0	0	2	0	0	0	2	3	3

	%CO	TARGET
17C309.1	74.32	65
17C309.2	73.92	65
17C309.3	78.67	65
17C309.4	74.73	65
17C309.5	85.42	65



	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
%PO ATT	2.43	2.80	2.80	2.62				1.87				1.64	2.05	2.24
TARGET	2.6	3	3	2.8				2				1.75	2.2	2.4



PROGRAM COMMITTEE MECH RYMEC
COURSE COMMITTEE CC MECH RYMEC
PROGRAM ASSESSMENT COMMITTEE PAC MECH RYMEC

RAO BAHADUR Y MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF MECHANICAL ENGNEERING
DIRECT AND INDIRECT ATTAINMENT 2019-20

Faculty: Mr.V BALARAJ **Code:** 17C309
Subject: FINITE ELEMENT ANALYSIS
SEM: VI **SEC:** A

COURSE OUTCOME STATEMENT	
17C309.1	Understand the concepts behind formulation methods in FEM.
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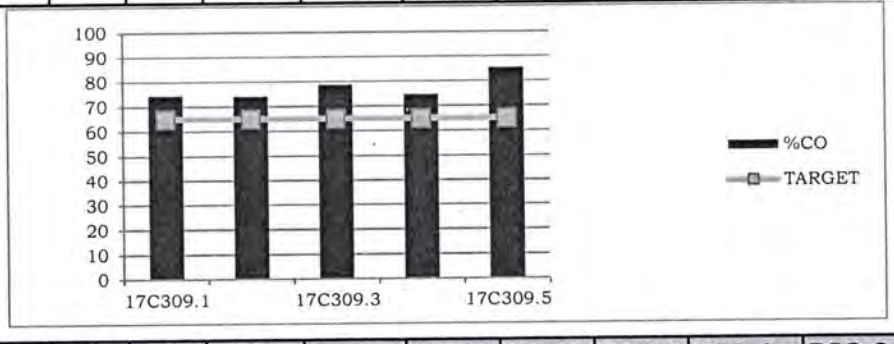
17C309.1	2	3	3	2	0	0	0	2	0	0	0	0	3	2
17C309.2	2	3	3	3	0	0	0	2	0	0	0	1	2	3
17C309.3	3	3	3	3	0	0	0	2	0	0	0	2	2	2
17C309.4	3	3	3	3	0	0	0	2	0	0	0	2	1	2
17C309.5	3	3	3	3	0	0	0	2	0	0	0	2	3	3

	%CO	TARGET
17C309.1	74.54	65
17C309.2	74.1	65
17C309.3	78.57	65
17C309.4	74.58	65
17C309.5	85.4	65



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%PO ATT	2.43	2.80	2.80	2.62				1.87				1.64	2.05	2.24
TARGET	2.6	3	3	2.8				2				1.75	2.2	2.4