Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

	Course Title: **INDUSTRIAL MANAGEMENT**		
	Scheme (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15ME51T**
	Type of Course: **Lectures, Self Study & Quiz**	Credit **:04**	Core/ Elective: **Core**
CIE- 25 Marks			SEE- 100 Marks

Prerequisites: Knowledge of English Communication and Discipline Courses

Course Objectives:

1. Technicians of mechanical engineering disciplines are expected to work during most of their career at middle level. They are also expected to deal with workforce and management problems.
2. In the present era of competition, optimum utilization of the resources with achieving higher productivity is essential for any industry to survive. Quality and cost controls are also other important factors which contribute to the day to day supervision issues.

COURSE OUT COMES

On successful completion of the course, the students will be able to:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Interpret given organization structure, and acquire major management skills, familiarize with different leadership styles	***R/U/A***	2,8,9	**08**
CO2	List stages in product design, and explain different types of plant layout, Production modes and PPC functions	***R/U/A***	2,4	**08**
CO3	Explain material requirement planning and store keeping procedure and analyze importance of inventory control	***R/U/A***	2,4	**11**
CO4	Explain the need of Total Quality management and appreciate the usage of TQM tools in quality control	***R/U/A***	2,4	**09**
CO5	Explain the different types of Plant maintenance and measures and procedure observed in industry towards safety	***R/U/A***	2,5	**08**
CO6	Appreciate the social responsibilities of engineer and ways to protect our environment	***R/U/A***	2,6	**08**
			Total Sessions	**52**

Legend: R; Remember, U: Understand A: Application

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
INDUSTRIAL MANAGEMENT	**0**	**03**	**00**	**02**	**01**	**01**	**00**	**01**	**01**	**00**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.
Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

Unit No	Unit Name	Hour	Questions to be set for SEE/MARKS			Marks Weightage	Weightage (%)
			R	U	A		
1	BASICS OF MANAGEMENT	08	05	05	10	20	13.79
2	PRODUCTION MANAGEMENT	08	05	05	10	20	13.79
3	MATERIALS MANAGEMENT	11	05	10	20	35	24.16
4	TOTAL QUALITY MANAGEMENT	09	05	05	20	30	20.68
5	PLANT MAINTENANCE AND INDUSTRIAL SAFETY	08	05	05	10	20	13.79
6	SOCIAL ISSUES AND THE ENVIRONMENT	08	05	05	10	20	13.79
	Total	52	30	35	80	145	100

Legend: R; Remember, U: Understand A: Application

UNIT I : BASICS OF MANAGEMENT 08Hrs

Management - Definition – Administration- Definition – Henry-Fayol's principles of management- Business Organisation-Types- Proprietorship-Partnership- Joint stock- Co-operative Society-Advantages and disadvantages -Functions of Management – Planning-Definition-Functions-Organisation-Definition- types of organisation –Line-Functional-Line &staff-advantages and disadvantages- Leadership -Types –Quality of good leader-Motivation - Maslow's Theory of Motivation -Hierarchy of needs- Communication - Process of Communication – Barriers for effective communication.

UNIT II : PRODUCTION MANAGEMENT 08Hrs

Concept of project work - Project planning -Market survey- Project capacity-selection of site for project- Plant layout-Types of Plant layout- Product design-Stages in product design-drawing-Specifications-Material requirement-operation-Planning-Production-definition-Job, Batch & Mass production with their advantages and disadvantages-Productivity-definition-factors to improve productivity- Production planning and Control (PPC)-definition-Functions of PPC- planning, routing, scheduling, dispatching and Inspection-Introduction to CPM and PERT –Comparision.

UNIT III : MATERIALS MANAGEMENT 11Hrs

Material management - definition, functions- Purchase - Objectives, different methods of purchasing -Purchase procedure-Comparative statement-purchase order-Tender-Types of tender- Storekeeping- classification of stores - Functions of store keeper. Store management-Bin Card - Material Issue Requisition- Material Returned Note- Store ledgers -Codification of stores-Inventory Management- Definition - functions of Inventory Control- Advantages of Inventory Control

Enterprise resource planning - concept, features and applications.- Material Requirement Planning (MRP)-concept, applications -Just in Time (JIT)-concept and benefits-Supply chain management-concept and benefits –FIFO(first in first out) concept-definition.

UNIT IV: TOTAL QUALITY MANAGEMENT 09 Hrs

Quality–Concept-Quality control- Definition - Factors affecting quality- Advantages of quality control –Inspection-Different types of inspection

Total Quality Management-Meaning- Principles of total quality management-PDCA cycles-Quality Circles-definition-Function.

TQM Tools- Flow charts, Control charts, Histograms, Pareto charts, Cause and effect diagram-5-S- Kaizen, and Six-sigma

Quality Certification Systems- ISO 9000 series quality standards, QS14000– ISO 9000, ISO 9001,ISO9002,ISO9003 & ISO 9004- ISO9000 quality certification procedure.

UNIT V: PLANT MAINTENANCE AND INDUSTRIAL SAFETY 08 Hrs

Plant maintenance-Definition -Types of maintenance-Preventive maintenance- Break down maintenance-Advantages and disadvantages- Total Productive Maintenance-Meaning-benefits of TPM -Tools of TPM- planned maintenance and predictive maintenance.

Industrial safety –Meaning - Accident- causes for accident- Direct and indirect losses due to an accident-Personal protective devices for preventions of accidents-Safety department- role of safety officer – safety supervisor -safety committee – Fire prevention and Protection- Fire triangle-principles of fire extinguishing- various classes of fire- A, B,C, D types of fire extinguishers

UNIT VI: SOCIAL ISSUES AND THE ENVIRONMENT 08 Hrs

Environment - Definition and scope-Solid waste management: causes, effects and control measures of municipal solid wastes (hospital wastes, hazardous wastes and e-wastes)- Water conservation and rain water harvesting. Climate change: global warming, acid rain, ozone layer depletion.-environment and human health-role of information technology in environment and human health

TEXT BOOKS AND REFERENCES

Sl.No.	Title of Books	Author	Publication
1.	Industrial Organization and Engineering Economics	T.R.Banga & S C Sharma	Khanna.Publishers
2.	Industrial management and organizational behavior	K.K.Ahuja	-
3	Industrial management and engineering economics	O.P.khanna	Khannapublishers
4.	Production and operations management	-Dr .K.Aswathappa and Dr.Sreedhar Bhatt	Himalaya publishers
5	Safety Management in Industry	Krishnan.N V	Jaico Publishing House, Bombay, 1997
6	Total Quality Management	S Raja Ram, Shivashankar	-
7	Project planning and control with PERT&CPM	By Dr.P.C. PUNMIA & K.K.KHANDELWAL	LP Publication, New Dhelli

LIST OF SOFTWARES/ LEARNING WEBSITES:

1. www.youtube.com/watch?v=SF53ZZsP4ik
2. www.youtube.com/watch?v=iPZlQ3Zx5zc

SPECIAL INSTRUCTIONAL STRATEGIES

UNIT NO	UNIT NAME	STARATEGIES
1	BASICS OF MANAGEMENT	Showing charts, presentations, Video movies
2	PRODUCTION MANAGEMENT	Presentations, Video movies, Expose to real life industries situation, industrial visits
3	MATERIALS MANAGEMENT	Discussions, real life industries situation, industrial visits. Expose to practiced procedures
4	TOTAL QUALITY MANAGEMENT	Teaching, Presentations, Industrial visits, movies.
5	PLANT MAINTENANCE AND INDUSTRIAL SAFETY	Industrial visits, movies
6	SOCIAL ISSUES AND THE ENVIRONMENT	Discussions, real life industries situation, industrial visits

SUGGESTED LIST OF STUDENT ACTIVITIES

Note: the following activities or similar activities for assessing CIE (IA) for 5 marks (Any one)

- Each student should do any one of the following type activity or similar activity related to the course and before take up, get it approved from concerned Teacher and HOD.
- Each student should conduct different activity and no repeating should occur

1	Each student will give an activity to prepare Comparative statement, Placing the purchase order with necessary terms and conditions
2	Given the data, prepare the scheduling using Gantt chart.
3	Each student will give an activity to visit local municipality garbarage plant, how the

	garbarage has been segregated. List the harm full effects of your local garbarage dump yard on the nearby environment
4	Identify any one product ,being manufactured in local industry, Study the process they are following for manufacturing the product, submit hand written report
5	Visit a nearby industry, make a report on Plant layout, type of production, quality system is put in practice and quality tools they are using in work place
6	Motivate student to take case study on plant maintenance of nearby industry, observe what type of maintenance they undertake in their industry.
7	Each student should prepare a detailed project report on selected product.

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	Three IA tests(Average of three tests will be computed)	20	Blue books	1,2,3,4,5,6
				Student Activities	05	Activity sheets	
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1, 2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaire	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

CIE- Continuous Internal Evaluation SEE- Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks evaluated through appropriate rubrics.
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS MODEL

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfil team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity.

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th weak of sem 10-11 Am	VSEM	**INDUSTRIAL MANAGEMENT**	20
	Year: 2016-17	Course code:15ME51T	

Name of Course coordinator : Topic: Units:1,2 **CO: 1,2**

Note: Answer all questions

Question no	Question	MARKS	CL	CO	PO
1	List the barriers for effective communication. OR List the advantages and limitations of planning.	5	R	1	2,9
2	Develop the line diagram to suit a Functional organisation for pharmaceutical industry.	5	A	1	2
3	Explain job production and mention its advantages and disadvantages OR Explain routing procedure	5	U	2	2
4	Identify the factors to be considered to improve productivity in an organisation.	5	A	2	2

MODEL QUESTION PAPER(SEE)

V Semester Diploma Examination

INDUSTRIAL MANAGEMENT

Time: **3 Hours**] [Max Marks**: 100**

Note: Answer any **SIX** from Part A and any **SEVEN** from Part B

Part A

6x5=30 marks

1. Define planning and mention objectives of planning
2. Explain briefly the process of communication
3. Define planning and mention the functions of planning
4. Explain batch production and mention its advantages and disadvantages
5. List the duties of purchasing officer
6. List the objectives of plant maintenance
7. Explain break down maintenance and mention its advantages and disadvantages
8. List the effects and control measure for global warming
9. Explain the factors affecting for climate change

Part B

1. Illustrate the business organisation and explain Proprietorship organisation.
2. What are the duties and responsibilities of chief inspector
3. Develop the specimen copy for preparation of comparative statement
4. List the applications of Material Requirement Planning (MRP)
5. Explain centralized stores and mention its advantages & disadvantages
6. Illustrate Histogram with graphical representation
7. Illustrate ISO 9000–Requirements and Benefits
8. Explain the duties, functions and responsibilities of plant maintenance department
9. What are the causes and effects of environmental pollution
10. a) Define quality control and mention the objectives of quality control
    b) Explain 5S house keeping

MODEL QUESTION BANK

V- Semester Diploma Examination

INDUSTRIAL MANAGEMENT

Note: *The paper setter is of liberty to set the questions on his/her desecration based on cognitive levels notified for that unit. They have to follow only blue print of SEE question paper format. The model question bank is only for reference to students/course coordinator to initiate the process of teaching-learning only.*

CO-1: Interpret given organization structure, and acquire major management skills, familiarize with different leadership styles.

Remember

1. List Henry Fayol's principles of management
2. List the types of Business Organization
3. Define sole proprietorship and list advantages and disadvantages of proprietorship.
4. List the applications of proprietorship
5. Define Partnership Organization and mention the applications of Partnership Organization
6. List the advantages and disadvantages of Partnership Organization
7. List the advantages and disadvantages of Joint Stock Company
8. List the advantages and disadvantages of Co-operative society
9. Define planning and mention objectives of planning
10. List the advantages and limitations of planning
11. Define organization and list the types of organization.
12. Define leadership and explain types of leaders
13. List the qualities of good leader
14. Define motivation and state Maslow's theory of motivation
15. Define communication and mention the elements of communication
16. What are the barriers for effective communication
17. What are the functions of management

Understanding

1. Explain management
2. Explain administration
3. Explain the formation of partnership and List the types of partners for Partnership Organization
4. Explain about Joint Stock company
5. Explain two types of Joint Stock Company a. Private limited company and b. private limited company
6. Explain Co-operative society and state the objectives of Co-operative society
7. Explain line organization and mention its advantages and limitations.
8. Explain functional organization and mention its advantages and limitations.

9. Explain Line & staff organization and mention its advantages and limitations.
10. Explain the process of communication

Application

1. Apply the reasons for Proprietorship organisation best suit for small business organisation.
2. Apply the reasons for partnership organisation best suit for small business organisation.
3. Identify the requirements to start - Joint stock organisation.
4. Select best - Co-operative Society organisation for societal needs
5. Develop Line organisation with its advantages.
6. Develop Line &staff organisation with its advantages
7. Develop Functional organisation with its advantages

CO-2: List stages in product design, and explain different types of plant layout, Production modes and PPC functions

Remember

1. Define production and explain the needs for production
2. Define productivity
3. List the factors to improve productivity
4. Define production-planning and control and mention its needs
5. Define planning and mention the functions of planning
6. Define scheduling and explain master schedule
7. Define scheduling and explain manufacturing schedule
8. Define despatching and mention its types
9. List the functions of despatching
10. Define inspection and mention the objects of inspection
11. What are the inspection standards
12. List the functions of inspection department
13. Which are the types of Inspection
14. Define PERT & CPM
15. What are the duties and responsibilities of chief inspector

Understanding

1. Explain job production and mention its advantages and disadvantages.
2. Explain batch production and mention its advantages and disadvantages.
3. Explain mass production and mention its advantages and disadvantages.
4. Explain routing.
5. Explain centralised despatching.
6. Explain decentralised despatching.
7. Explain centralised inspection and mention its advantages and disadvantages
8. Explain Floor Inspection and mention its advantages and disadvantages
9. Explain Patrolling Inspection and mention its advantages and disadvantages

10. Explain the role and application of PERT and CPM for project scheduling

Application

1. Identify the factors for routing
2. Select the functions of PPC
3. Select the functions of despatching
4. Identify the factors affecting the productivity.

CO-3: Explain material requirement planning and store keeping procedure and analyze importance of inventory control

1. **Remember**
2. Define material management and mention its functions
3. Define purchase and mention the objects of purchasing department
4. What are the duties of purchasing officer
5. Define the terms and forms used in purchase department
6. Define tender
7. Define storekeeping and explain the purpose of store keeping
8. List the classifications of store
9. Define bin card and write the specimen copy of bin card
10. Define store ledgers and write the codification of stores
11. List the advantages of good store keeping
12. What are the advantages and disadvantages of inventory control
13. List the benefits of Just in Time (JIT)
14. What are the benefits of Supply chain management

Understanding

1. Explain the different methods of purchasing
2. Explain different types of tender
3. Explain centralized stores and mention its advantages & disadvantages
4. Explain decentralized stores and mention its advantages & disadvantages
5. Explain the methods of storing
6. Explain material return note and write the specimen copy of material return note
7. Explain stock or inventory control and mention the functions of inventory control
8. Explain the steps in inventory control
9. Infer the concept and features of Enterprise resource planning
10. Illustrate the concept of Material Requirement Planning (MRP)
11. Explain the concept Just in Time (JIT)
12. Explain the concept of Supply chain management
13. Explain First in First out Method
14. Outline the advantages AND disadvantages of FIFO

Application

1. Identify the functions of purchasing department
2. Select the procedure for purchasing the materials
3. Develop the purchase requisition format
4. Develop the specimen copy for preparation of comparative statement
5. Develop the Performa of purchase order
6. Construct the layout of stores organization and list the duties of store keeper
7. Develop the specimen copy of materials issue requisition form
8. Identify the applications of Enterprise resource planning
9. Identify the applications of Material Requirement Planning (MRP)

CO-4: Explain the need of Total Quality management and appreciate the usage of TQM tools in quality control

Remember

1. Define quality and list the factors affecting quality
2. Define quality control and mention the objectives of quality control
3. List the advantages of quality control
4. Define Total quality management
5. Define the principles of Total quality management
6. Define quality circle and mention its functions
7. list different types of control charts
8. Define flow charts
9. What are the benefits in implementing 5S
10. List the benefits of ISO 14000

Understanding

1. Explain continuous process improvement in TQM
2. Explain basic concepts of TQM
3. Explain the benefits of TQM
4. Explain about PDCA cycles
5. Explain about control charts
6. Explain 5S house keeping
7. Explain Kaizen principle
8. Explain about Six Sigma concepts
9. Illustrate the Need for ISO 9000- ISO 9000-2000 Quality System
10. Explain about ISO 9000 Family

Application

1. Identify the functions of quality control department
2. Develop Histogram with graphical representation
3. Construct Pareto charts with graphical representation
4. Construct and Illustrate the Cause-and-Effect Diagram

5. Identify QS 9000 – ISO 14000 –Requirements and Benefits
6. Identify the Obstacles associated with TQM Implementation

CO-5: Explain the different types of Plant maintenance and measures and procedure observed in industry towards safety

1. **Remember**

2. Define plant maintenance and explain its needs
3. List the objectives of plant maintenance
4. List the types of maintenance
5. List personal protective devices for preventions of accidents
6. Define safety department and mention the objectives of safety department

Understanding

1. Explain Preventive maintenance
2. Explain Corrective maintenance
3. Explain Predictive maintenance
4. Explain scheduled maintenance
5. Explain plant maintenance schedule
6. Explain break down maintenance and mention its advantages and disadvantages
7. Explain Total Productive Maintenance
8. Explain planned maintenance
9. Explain industrial safety and mention the needs and importance of safety
10. Explain industrial accidents and accident sequences
11. Summarise the Direct and indirect losses due to an accident
12. Explain the role of safety officer , safety supervisor and safety committee
13. Explain Fire prevention and Protection
14. Explain detection and prevention of fire, fire alarms and fire extinguisher

Application

1. Identify the duties, functions and responsibilities of plant maintenance department
2. Select the benefits of Total Productive Maintenance
3. Develop the Organization Structure for TPM Implementation.
4. Identify the types of fire and construct fire triangle.
5. Identify the causes for accident

CO-6: Appreciate the social responsibilities of engineer and ways to protect our environment

1. **Remember**

1. Define environment and explain the scope of environment
2. What are the effects of municipal solid wastes.
3. List the advantages of rain water harvesting.

4. Define climate change.
5. List the effects and control measures for global warming.
6. List the effects and control measures of acid rain.
7. List the effects and control measures for ozone layer depletion.
8. Relate the role of information technology in environment and human health.

Understanding

1. Explain Solid waste management.
2. Explain the factors affecting for climate change.
3. Explain global warming.
4. Explain acid rain.
5. Explain ozone layer depletion.
6. Interpret about environment and human health.

Application

1. Identify the causes and effects of environmental pollution.
2. Plan the control measures of municipal solid wastes.
3. Identify the causes of municipal solid wastes
4. Making use of rain water harvesting technique plan water conservation for future.

Government of Karnataka
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	Course Title: **APPLIED THERMAL ENGINEERING**		
	Scheme (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15ME52T**
	Type of Course: **Lectures, Self Study & Quiz**	Credit **:04**	Core/ Elective: **Core**
CIE- 25 Marks			SEE- 100 Marks

Prerequisites: Knowledge of Engineering Mathematics, Applied Science and Basic Thermal Engineering

Course Objectives:

1. This course will provide the basic knowledge of thermal engineering which will function as foundation in applications in major fields of mechanical engineering and technology notably in steam and nuclear power plants.
2. This course would develop knowledge and skills related to boilers, boiler mountings and accessories, compressors, heat exchangers, steam turbines etc. This course is thus very important for mechanical engineer.

Course Outcomes:

On successful completion of the course, the students will be able to attain CO:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Determine steam properties and dryness fractions.	***R/U/A***	1,2	**10**
CO2	Classify and explain boilers, boiler mountings and accessories	***R/U/A***	2	**09**
CO3	Identify the elements and processes of steam condensers and cooling towers And working of steam Nozzles	***R/U/A***	1,2	**11**
CO4	Understand the working of steam Turbines	***U/A***	1,2	**10**
CO 5	Operate air compressors and observe the parameters affecting the performance	***R/U/A***	1,2	**06**
CO6	Know the mechanism of refrigeration, and its types and different air conditioning system	***R/U***	2	**06**
		Total sessions		**52**

Legend: R; Remember, U: Understand A: Application An: Analysis

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
APPLIED THERMAL ENGINEERING	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

Unit No	Unit Name	Hour	Questions to be set for SEE/Marks			Marks Weightage	Weightage (%)
			R	U	A		
1	**FORMATION OF STEAM**	10	**5**	**5**	**20**	**30**	**20.69**
2	**STEAM BOILERS**	10	**5**	**10**	**10**	**25**	**17.25**
3	STEAM CONDENSERS, COOLING TOWERS **AND STEAM NOZZELS**	10	**10**	**10**	**10**	**30**	**20.69**
4	**STEAM TURBINES**	10	**-**	**10**	**20**	**30**	**20.69**
5	AIR COMPRESSORS	06	**-**	**5**	**10**	**15**	**10.34**
6	**REFRIGERATION AND AIR CONDITIONING**	06	**5**	**10**	**-**	**15**	**10.34**
	Total	**52**	**25**	**50**	**70**	**145**	**100**

Legend: R; Remember, U: Understand A: Application

UNITI: FORMATION OF STEAM 10 Hrs

Concept of two phase system - Formation of steam- Definition and representation of wet steam, dry steam, saturated steam and superheated steam on T-H Diagram.

Concept and determination of dryness fraction-Degree of superheat-Latent heat-sensible heat, enthalpy-entropy-Internal energy-External work of evaporation and specific volume of steam-Use of Steam tables and Mollier chart- (Heat Entropy Chart).-Numerical examples based on above.

Steam vapour cycles-Carnot cycle- Schematic diagram –Representation on PV & T-S diagram-Rankine cycle-Schematic diagram- Representation on PV & T-S diagram-(No numerical Problems on steam vapour cycles)

Steam Calorimeters- Barrel Calorimeter, Separating Calorimeter, Throttling Calorimeter and combined Separating & Throttling calorimeters.-Limitations of Calorimeter-(No numerical Problems on Calorimeters).

UNIT II: STEAM BOILERS 10 Hrs

Steam boiler-Concept-definition-Indian Boilers Regulation (IBR)- Classification of boiler – function of boiler- Low pressure boilers- Sketch and working of Cochran boiler- Babcock and Wilcox boiler-Merits and demerits- High pressure boilers- Sketch and working of Lamont and Benson boiler- Merits and demerits- Comparison of water tube and fire tube boilers- Boiler mountings and accessories, Boiler draught system-concept and classification -steam jet draught.

UNIT III: STEAM CONDENSERS, COOLING TOWERS & NOZZELS 10Hrs

Introduction-Steam condenser-Concept-Classification-Functions- Jet condensers and surface condensers-working-merits and demerits of surface condensers over jet condensers -Cooling towers- Classification, function and working.

Steam nozzles-concept-Types-Flow of steam through convergent-divergent nozzle-Friction in a nozzle-Discharge of steam through nozzles-Critical pressure ratio (no derivation)-Methods of calculation of cross sectional areas at throat and exit for maximum discharge-Effect of friction in nozzles-Supersaturated flow through nozzle- Numerical on nozzles using Mollier Chart only.

UNIT IV: STEAM TURBINES 10 Hrs

Steam turbine –concept- classification - Working principle with line diagram of a simple De-Laval turbine – velocity diagram of impulse turbine- Expression for work done, axial thrust, tangential thrust, blade and diagram efficiency, nozzle efficiency- Compounding of steam turbine-Need for compounding- Pressure compounding.- Velocity compounding- Pressure velocity compounding. Problems on single stage impulse turbines (graphical method only) – Concept of reaction turbines – Parson's – Delaval (No numerical).

UNIT V: AIR COMPRESSOR 06 Hrs

Air compressor-concepts, functions, classification and applications- Single stage reciprocating air compressor- construction and working (with line diagram) Expression for work done and power required by single stage reciprocating compressor (without derivation), Simple problems on work done and power required.

Multi stage compression – advantages of multistage compression-Rotary Compressors - working of rotary Compressor-Difference between reciprocating and rotary compressors - concept of screw compressor (oil free).

UNIT VI: REFRIGERATION AND AIR CONDITIONING 06 Hrs

Refrigeration - Definition -Unit of refrigeration -Coefficient of performance (COP)-Vapour compression refrigeration with flow diagram-Vapour absorption refrigeration with flow diagram- Refrigerants –Types- Factors affecting the choice of refrigerants- properties of good refrigerants.

Psychrometry- definition-Psychrometric terms - dry air, saturated air, dry bulb temperature-Wet bulb temperature, dew point temperature, relative humidity, absolute humidity, specific humidity.

Air Conditioning- classification-winter Air Conditioning-Summer Air conditioning-Year round air conditioning-

REFERENCES

Sl.No.	Title of Books	Author	Publication
1.	Heat Engines	Pandya and Shah	Charotar Publishing House
2.	Thermodynamics and Heat power Engg.	Mathur and Mehta	Tata Mcgraw- Hill
3	A Text book of Thermal Engineering	R S Khurmi& J K Gupta	S Chand
4.	Thermal Engineering	P.L. Ballaney	Khanna.Publishers
5	Thermal Engineering	A. S. Sarao	SatyaPrakashan
6	Thermal Engineering	R K Rajput	Laxmi.Publications
7	Practical Thermodynamics	G D Rai	Khanna Publisher
8	Thermal Engineering	Mahesh M Rathore	Mcgraw- Hill Education
9	Basic and applied thermodynamics	P K Nag	McGraw Hill education

LIST OF SOFTWARES/ LEARNING WEBSITES:

a. http://www.nptel.iitm.ac.in/video.php?subjectId=112105123 (IIT-B Video lectures)
b. http://www.thermofluids.net/
c. http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv301-Page1.htm
d. http://www.grc.nasa.gov/WWW/k-12/airplane/thermo.html
e. http://www.youtube.com/watch?v=Xb05CaG7TsQ
f. http://www.youtube.com/watch?v=aAfBSJObd6Y
g. http://www.youtube.com/watch?v=DHUwFuHuCdw
h. http://www.youtube.com/watch?v=kJlmRT4E6R0
i. http://www.youtube.com/watch?v=GKqG6n6nAmg

SUGGESTED LIST OF STUDENT ACTIVITYS

Note: the following activities or similar activities for assessing CIE (IA) for 5 marks (Any one)

- Each student should do any one of the following type activity or similar activity related to the course and before take up, get it approved from concerned Teacher and HOD.
- Each student should conduct different activity and no repeating should occur

1	Interpret steam tables, mollier chart and relationship between different thermodynamic properties.
2	Prepare Mollier charts and show different regions.
3	Visit to sugar factory / Dairy / steam power plant, Prepare Hand written Report on specifications of boiler and list of mountings and accessories with their functions, safety measured observed.
2	At least one visit of any power plant/ industry, student should observe the operational aspects, safety in handling boiler, air compressor, heat exchanger, cooling tower, condenser etc. and submit hand written report.
3	Collect/ the details and specifications of various types of Steam condensers/Cooling towers used in industry.
4	Collect/ download product catalogues with specification of various types of Air compressors used in industry.

5	Each student should prepare a detailed report showing the construction/components/Working of Domestic refrigerator or Air Conditioners

SPECIAL INSTRUCTIONAL STRATEGIES

UNIT NO	UNIT NAME	STARATEGIES
1	FORMATION OF STEAM	lectures and Power point presentations/ Video/ Video movies
2	STEAM BOILERS	Lectures/Presentations, Showing charts, Video movies, Expose to real life industries situation, industrial visits
3	STEAM CONDENSERS, COOLING TOWERS AND STEAM NOZZELS	Lectures/Presentations, Showing charts, Video movies, Expose to real life industries situation, industrial visits
4	STEAM TURBINES	Lectures/Presentations, Showing chart, Expose to real life industries situation, industrial visits.
5	AIR COMPRESSORS	Lectures/Presentations, Showing chart,
6	REFRIGERATION AND AIR CONDITIONING	Lectures/Presentations, Showing chart, Expose to real life industries situation, industrial visits

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	Three IA tests (Average of three tests will be computed)	20	Blue books	1,2,3,4,5,6
				Student activities	05	Activities sheets	
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

CIE- Continuous Internal Evaluation SEE- Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks evaluated through appropriate rubrics.
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS MODEL

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th week of sem 10-11 Am	VSEM	**APPILED THERMAL ENGG.**	20
	Year: 2016-17	Course code:15ME52T	

Name of Course coordinator : Units:1,2 Co: 1,2

Note: Answer all questions

Question no	Question	MARKS	CL	CO	PO
1	Explain Barrel type Steam Calorimeters with a neat sketch. OR Explain Separating type Steam Calorimeters with a neat sketch	5	U	2	2
2	Make use of the given data find the quantity of heat required to produce 1kg of steam at a pressure of 6 bar at a temperature of 25^0C, under the following conditions. a)When the steam is wet having a dryness fraction 0.9, b)when the steam is dry saturated, c)when it is superheated at a constant pressure at 250^0C assuming the mean specific heat of superheated steam to be 2.3 kJ/kg^{0}K.	5	A	1	2
3	Choose the different system of producing draught in a boiler and mention their advantages and disadvantages	5	A	2	2
4	Explain the various types of draughts used in usual practice. OR Compare the advantages of high pressure boiler over low pressure boiler.	5	U	2	2

MODEL QUESTION PAPER (SEE)

V- Semester Diploma Examination

Course Title: **APPILED THERMAL ENGINEERING**

Time: **3 Hours**] [Max Marks**:** **100**

Note: Answer any **SIX from PartA** and any **SEVEN from Part B**

PART-A 6x5=30 marks

1. List the advantages of superheated steam
2. Explain Barrel type Steam Calorimeters with a neat sketch
3. List the various types of draughts used in usual practice.
4. List the different types of steam - condensers.
5. List the function of cooling tower in a modem condensing plant
6. Explain the Working of simple De-Laval turbine with line diagram
7. Summarise the advantages and disadvantages of velocity compounded impulse turbines.
8. List the desirable properties of a secondary refrigerant.
9. Explain Single stage reciprocating air compressor with line diagram

PART-B 7x10=70 marks

1. Steam at 18 bar and dryness 0.9 is heated at constant pressure until dry and saturated. Find the increase in volume, heat supplied and work done per kg of steam. If the volume is now kept constant, find how much heat must be extracted to reduce the pressure to 14 bar.
2. Make use of the steam table,find the following : (i) Enthalpy and volume of 1 kg of steam at 12. 1 bar and dryness fraction 0.9, and (ii) Enthalpy and volume of 1 kg of steam at 12. 1 bar and 225'C. Take the specific heat at constant pressure for superheated steam as 2.1 kJ/kg K.
3. i) Compare high pressure boiler and low pressure boiler
   ii) Explain the function of the safety valve
4. Outline the sketch and explain the working of a La-mount boiler
5. Outline the sketch and explain counter-flow low level jet condenser and list the advantages.
6. A convergent-divergent nozzle is required to discharge 2 kg of steam per second. The nozzle is supplied with steam at 7 bar and 180^0C and discharge takes place against the back pressure of 1 bar. The expansion up to throat is isentropic and the frictional resistance between throat and exit is equivalent to 63 kJ/kg of steam. The approach velocity to the nozzle is 75 m/s and throat pressure is 4 bar. Estimate (a) Suitable areas of throat and exit, (b) Overall efficiency of the nozzle based on enthalpy drop between inlet pressure, temperature and exit pressure.
7. An impulse turbine with a single row wheel is to develop 99.3 kW, the blade speed being 150 m/sec. A mass of 2 kg of steam per second is to flow from the nozzles at a speed of 350 m/sec. The velocity coefficient of the blades may be assumed to be 0.8 while the steam is to flow axially after passing through the blades ring. Determine the

nozzle angle, and the blade angles at inlet and exit assuming no shock. Estimate also the diagram efficiency of the blading.

8. The steam leaves the nozzle of a single-stage impulse wheel turbine at 900 m/sec. The nozzle angle is 20°, the blade angles are 30° at inlet and outlet, and friction factor is 0.8. Calculate : (a) the blade velocity, and (b) the steam flow in kg per hour if the power developed by the turbine is 257'kW.

9. a) Explain winter Air Conditioning with neat sketch.
   b) Explain Summer Air conditioning with neat sketch

10. It is desired to compress 17m^3 of air per minute from 1 bar (100 kN/m2) and 21'C to a delivery pressure of 7 bar (700 kN/m^2) in a single-stage, single-acting air compressor. Calculate the power required to drive the compressor and the heat rejected duhng compression to cooling water if the compression is (a) Isentropic (y = 1.4 for air), and (b) Isothermal.

MODEL QUESTION BANK

Diploma in Mechanical Engineering

V Semester

Course title: APPILED THERMAL ENGINEERING

Note: ***The paper setter is of liberty to set the questions on his/her desecration based on cognitive levels notified for that unit. They has to follow only blue print of SEE question paper format. The model question bank is only for reference to students/course coordinator to initiate the process of teaching-learning only.***

CO-1: Determine steam properties and dryness fractions.

REMEMBER

1. What is meant by saturation temperature and saturation pressure?
2. Define the following terms : (i) Saturated steam, (ii) Dry saturated steam, (Hi) Wet steam, (iv) superheated steam, (v) Dryness fraction of steam, (vi) Specific volume of steam, and (vii) Saturated water.
3. List the advantages of superheated steam
4. Define Internal energy of steam.

UNDERSTAND

1. Explain the process of formation of steam at a constant pressure from water.
2. Explain how the wet steam, dry saturated steam and superheated steam is produced.
3. Explain T-H diagram during steam formation.
4. Explain steam tables and their uses.
5. Explain Carnot cycle with Sketch
6. Explain with sketch Rankine cycle
7. Explain Barrel type Steam Calorimeters with a neat sketch.
8. Explain Separating type Steam Calorimeters with a neat sketch
9. Explain Throttling type Steam Calorimeters with a neat sketch
10. Explain combined Separating & Throttling type Steam Calorimeters with a neat sketch
11. Compare enthalpy and internal energy of steam
12. Outline the Limitations of Calorimeter.
13. Explain the following terms : (i) Saturated steam, (ii) Dry saturated steam, (Hi) Wet steam, (iv) superheated steam, (v) Dryness fraction of steam, (vi) Specific volume of steam, and (vii) Saturated water.
14. Explain the following terms as referred to steam : (i) Enthalpy of water, (ii) Enthalpy of evaporation, (iii) Superheat, (iv) Specific volume, and (v) Enthalpy of dry saturated steam.
15. Compare saturated steam and dry saturated steam.

APPLICATION

1. Make use of the given data find the quantity of heat required to produce 1kg of steam at a pressure of 6 bar at a temperature of 25^0C, under the following conditions.
   a)When the steam is wet having a dryness fraction 0.9, b)when the steam is dry saturated, c)when it is superheated at a constant pressure at 250^0C assuming the mean specific heat of superheated steam to be 2.3 kJ/kg^{0}K.
2. Steam enters an engine at a pressure of 12bar with 67^0C of superheat. It is exhausted at a pressure of 0.15bar and 0.95dry. Find the drop in enthalpy of steam.

3. Make use of the given data find the internal energy of 1kg of superheated steam at a pressure of 10bar and 280^0C.
   If this steam be expanded to a pressure of 1.6bar and 0.8dry, determine the change in internal energy. Assume specific heat of superheated steam as 2.3 kJ/kg^{0}K.
4. A vessel contains 20kg of steam at a pressure of 8 bar. Find the amount of heat, which must be rejected, so as to reduce the quality of steam in the vessel to be 70%.
5. Steam at 18 bar and dryness 0.9 is heated at constant pressure until dry and saturated. Find the increase in volume, heat supplied and work done per kg of steam. If the volume is now kept constant, Analyze how much heat must be extracted to reduce the pressure to 14 bar.
6. Analyze how much heat is needed to convert 5 kg of water at 40'C into 90 per cent dry (or 10 per cent wet) steam at 5 bar (500 kPa) ? Take specific heat of water as 4. 187 kJ/kg K.
7. Analyze how much heat is needed to convert 4 kg of water at 20'C into steam at 8 bar (800 kPa) and 200'C. Take kp of superheated steam as 2.1 kJ/kg K and specific heat of water as 4.187 kJ/kg K.
8. Make use of the given data ,Find the volume of one kilogram of steam at a pressure of 15 bar (15 MPa) in each of the following cases : (i) when steam is dry saturated, (ii) when steam is wet having dryness fraction of 0.9, and (iii) when steam is superheated, the degree of superheat being 40'C.
9. Analyze the condition of steam in each of the following cases : (i) at a pressure of 10 bar and temperature 200'C, (ii) at a pressure of 8 bar and volume 0.22 m /kg, and (iii) at a pressure of 12 bar, if 2,688 kJ/kg are required to produce it from water at 0 'C.
10. Utilize steam table,and find (i) Enthalpy and volume of 1 kg of steam at 12. 1 bar and dryness fraction 0.9, and (ii) Enthalpy and volume of 1 kg of steam at 12. 1 bar and 225'C. Take the specific heat at constant pressure for superheated steam as 2.1 kJ/kg K.
11. Wet steam of mass 25 kg and occupying a volume of 0.49 m at 75 bar has a total heat (enthalpy) increase of 1,500 kJ when superheated at constant pressure. Determine : (i) Initial quality of steam, (ii) Final quality (degree of superheat) of steam, and (HI) Increase in volume of steam after superheating. Assume kp for the superheated steam to be 2-1 kJ/kg K.
12. Steam enters a steam engine at a pressure of 12 bar with 67'C of superheat and is exhausted at 0.15 bar and 094 dry. Calculate the drop in enthalpy from admission to exhaust, and volume of 1 kg of steam at admission and exhaust conditions. Take kp of superheated steam as 2.1 kJ/kg K.
13. Make use of the given data, find the external work done during evaporation, internal latent enthalpy and internal energy per kg of steam at a pressure of 15 bar (1,500 kPa) when the steam is (i) 09 dry, and (ii) dcy saturated.
14. 0.025 m3 of steam at 3.5 bar and dryness fraction 08 is converted into dry saturated steam at 11 bar. By how much are the enthalpy and internal energy changed ?
15. The internal energy of 1 kg of steam at a pressure of 14 bar (1.4 MPa) is 2,420 kJ. Calculate the dryness fraction of this steam. Find the increase in internal energy if this steam is superheated at constant pressure to a temperature of 295'C. Take kp of superheated steam as 2.3 kJ/kg K.
16. Inspect at what fraction of enthalpy of 1 kg of steam at 10 bar and 0.9 dry represents the internal energy ? What is the change in internal energy when the pressure and temperature of this steam is raised to 13 bar and 250'C ? Take kp of superheated steam as 2.1 kJ/kg K.

CO-2: Classify and explain boilers, boiler mountings and accessories

REMEMBERING

1. Define steam boiler and list its function.
2. List the types of boilers according to various factors
3. List the advantages of a Lancashire boiler
4. List the advantages of Cochran boilers
5. List the advantages and disadvantages of a locomotive boiler.
6. List the advantages and disadvantages of water-tube boilers.
7. List the advantages of water-tube boilers over fire-tube boilers and tank boilers.
8. List the boiler mountings.
9. List the different mountings and accessories with which the Babcock and Wilcox water-tube boiler is fitted
10. List the various types of draughts used in usual practice.

UNDERSTANDING

1. Explain the following terms used in boiler practice : (a) Boiler shell, (b) Fire grate, (c) Furnace, (f) Mountings, (g) Blowing-off
2. Expline the method of obtaining draught in the boiler.
3. Compare ‘water-tube’ and Fire-tube' boilers.
4. Explain the function of the safety valve .
5. Explain the function of the Fusible plug.
6. Outline the neat sketch of the Babcock and Wilcox water tube boiler.
7. Compare Natural draught and artificial draught.
8. Compare Forced draught and induced draught.
9. Compare how an artificial draught is considered advantageous over a natural draught
10. Explain the terms mechanical draught and balanced draught.
11. Explain the working principle of the steam jet draught.
12. Compare the advantages of high pressure boiler over low pressure boiler.
13. Compare high pressure boiler and low pressure boiler.

APPLICATION

1. Construct neat sketch and explain the Lancashire boiler.
2. Construct neat sketch and explain the Co-chran boiler
3. Construct neat sketch and explain the locomotive boiler.
4. Choose the different system of producing draught in a boiler and mention their advantages and disadvantages.
5. Construct neat sketch and explain the La-mount boiler.
6. Construct neat sketch and explain the working of a Benson boiler

CO-3: identify the elements and processes of steam condensers and cooling towers and working of steam nozzles.

REMEMBERING

1. List the function of a condenser in a modem steam condensing power plant.
2. list the different types of steam - condensers.
3. List the function of cooling tower in a modem condensing plant.
4. Define the term 'Nozzle efficiency.

UNDERSTANDING

1. Outline the Sketch and explain the working of Surface Condenser
2. Outline the Sketch and explain the working of Jet Condenser
3. Construct neat sketch of a barometric jet condenser and explain its working
4. Compare the merits and demerits of surface condensers over jet condensers
5. Construct neat sketch of a counter-flow low level jet condenser and explain its working.
6. Construct neat sketch and explain the operation of an evaporative condenser
7. Construct neat sketch and explain the working of any one type of cooling tower.
8. Explain the function of a steam nozzle. Explain the types of nozzles with sketch.
9. Explain the term critical pressure as applied to steam nozzles.
10. Explain the term "critical pressure" as applied to steam nozzles. Why are the turbine nozzles made divergent after the throat.
11. Explain he causes of supersaturated flow in nozzles.
12. Explain the supersaturated expansion of steam and give some idea of the limits within which this condition is possible.
13. Explain the Types of steam nozzles with neat sketches
14. Explain the Effect of friction on the flow of steam through convergent-divergent steam nozzles.
15. Explain the Effect of supersaturated flow in steam nozzles.

APPLICATION

1. A nozzle is to be designed to expand steam at the rate of 0.10kg/s from 500kpa, 210^0C to 100kpa. Neglect inlet velocity of steam. For a nozzle efficiency of 0.9, determine the exit area of the nozzle.
2. Steam enters a convergent – divergent nozzle at 2 MPa and 400^0C with a negligible velocity and mass flow rate of 2.5 kg/s and it exists at a pressure of 300 kPa. The flow is isentropic between the nozzle entrance and throat and overall nozzle efficiency is 93 percent. Determine (a) throat, and (b) exit areas.
3. In a convergent-divergent nozzle, the steam enters at 15 bar and 300^0C and leaves at a pressure of 2 bar. The inlet velocity to the nozzle is 150 m/s. Find the required throat and exit areas for mass-flow rate of 1 kg/s. Assume nozzle efficiency to be 90 percent and C_{ps}= 2.4 kJ/kgK
4. Determine the throat and exit diameters of a convergent-divergent nozzle, which will discharge 820 kg of steam per hour at a pressure of 8 bar superheated to 220 ^{0}C into a chamber having a pressure of 1.5 bar. The friction loss in the divergent portion of the nozzle may be taken as 0.15 of the isentropic enthalpy drop.
5. A convergent-divergent nozzle is required to discharge 2 kg of steam per second. The nozzle is supplied with steam at 7 bar and 180^0C and discharge takes place against the back pressure of 1 bar. The expansion up to throat is isentropic and the frictional

resistance between throat and exit is equivalent to 63 kJ/kg of steam. The approach velocity to the nozzle is 75 m/s and throat pressure is 4 bar. Estimate (a) Suitable areas of throat and exit, (b) Overall efficiency of the nozzle based on enthalpy drop between inlet pressure, temperature and exit pressure.

6. A turbine having a set of 16 nozzles receives steam at 20 bar and 400 ^{0}C. The pressure of steam at the nozzle exit is 12 bar. If the discharge rate is 260 kg/min and the nozzle efficiency is 90 %, calculate the cross-sectional area at the nozzle exit. If the steam has a velocity of 80 m/s at entry to the nozzle, find the percentage increase in discharge.
7. The steam is supplied to a nozzle at a rate of 1 kg/s from an inlet condition of 10 bar, dry saturated and exit at 1 bar pressure. The efficiency of the nozzle for the convergent portion is 95 percent and that of the divergent portion is 90 percent. Determine (a) throat and exit diameters of nozzle (b) length of nozzle, if divergent cone angle of the nozzle is 14^0. (c) The power in kW correspondence to exit velocity of the steam
8. A convergent-divergent nozzle is required to discharge 350 kg of steam per hour. The nozzle is supplied with steam at 8.5 bar and 90% dry and discharges against a back pressure of 0.4 bar. Neglecting the effect of friction, find the throat and exit diameters.

CO-4: Understand the working of steam Turbines

UNDERSTANDING

1. Compare Impulse and reaction turbines.
2. Explain the principle of working of impulse turbine.
3. Explain the Working of simple De-Laval turbine with line diagram
4. Outline the velocity diagram of a impulse turbine blades.
5. Explain the need for compounding.
6. Explain Blade efficiency and diagram efficiency.
7. Explain why steam turbines are compounded
8. Explain the Pressure compounding with diagrams
9. Explain the Velocity compounding with diagrams
10. Explain the Pressure-Velocity compounding with diagrams.
11. Explain the working of an Impulse reaction turbine.
12. Summarise the advantages and disadvantages of velocity compounded impulse turbines.
13. Explain Parson's reaction turbine.

APPLICATION

1. Steam issues from the nozzle of a simple impulse turbine with a velocity of 900 m/sec. The nozzle angle is 20°, the mean diameter of the blades is 25 cm and the speed of rotation is 20,000 r.p.m. m The mass flow through the turbine nozzles and blading is 0.18 kg of steam per sec. Draw the velocity diagram and derive or calculate the following : (a) Tangential force on blades, (b) Axial force on blades, (c) Power developed by the turbine wheel, (d) Efficiency of the blading, and (e) Inlet angles of

2. The rotor of an impulse turbine is 60 cm diameter and runs at 9,600 r.p.m. The nozzles are at 20° to the plane, of the wheel, and the steam leaves them at 600 m/sec. The blades outlet angle are 30° and the friction factor is 0.8. Calculate the power developed per kg of steam per second and the diagram efficiency.

3. An impulse turbine with a single row wheel is to develop 99.3 kW, the blade speed being 150 m/sec. A mass of 2 kg of steam per second is to flow from the nozzles at a speed of 350 m/sec. The velocity coefficient of the blades may be assumed to be 0.8 while the steam is to flow axially after passing through the blades ring. Determine the nozzle angle, and the blade angles at inlet and exit assuming no shock. Estimate also the diagram efficiency of the blading.

4. The steam leaves the nozzle of a single-stage impulse wheel turbine at 900 m/sec. The nozzle angle is 20°, the blade angles are 30° at inlet and outlet, and friction factor is 0.8. Calculate : (a) the blade velocity, and (b) the steam flow in kg per hour if the power developed by the turbine is 257'kW.

5. The outlet area of the nozzles in a simple impulse turbine is 15-5 err? and the steam leaves them 0.91 dry at 1.4 bar and at 920 m/sec. The blade angles are 30° at inlet and exit, and the blade velocity is 0.25 of the steam velocity at the exit from the nozzle. The friction factor is 0.8. Find : (a) the nozzle angle, (b) the power developed, (c) the diagram efficiency, and (d) the axial thrust on the blading.

6. A single stage impulse rotor has a blade ring diameter of 57.5 cm and rotates at a speed of 10,000 r.p.m. The nozzles are inclined at 20^0 to the direction of motion of the blades and the velocity of the issuing steam is 1050 m/sec. Determine the inlet blade angle in order that the steam shall enter the blades passage without shock. Assume a friction coefficient of the blading equal to 0.85 and that the inlet and outlet angles are equal. Find also: (a) the power developed at the blades for a steam supply of 1,350 kg per hour, (b) the diagram efficiency, and (c) the loss of kinetic energy due to blade friction.

CO5: Operate air compressors and observe the parameters affecting the performance

REMEMBERING

1. List the types of air compressors.
2. List the applications of the air compressor.
3. List the advantages of multi stage reciprocating air compressor.

UNDERSTANDING

1. Explain the uses of compressed air.
2. Classify the air compressor.
3. Explain Single stage reciprocating air compressor with line diagram.
4. Explain multi stage compression with line diagram.
5. Compare Reciprocating compressor with Rotary compressors.
6. Explain with Sketch the operation of a single-stage centrifugal compressor
7. Explain with Sketch the operation of a Screw compressor(oil free).

APPLICATION

1. A single-cylinder, single-acting reciprocating air compressor has a cylinder of 24 cm diameter and linear piston speed of 100 metres per minute. It takes in air at 100 kPa (100 kN/m2) and delivers at 1 MPa (1 MN/rrP), Determine the indicated power of the

compressor. Assume the law of compression to be $pv^{1.25}$ = constant ture of air at inlet is 288 K. Neglect clearance effect.

2. A single-acting, single-stage air compressor developing indicated power of 11 kW, runs at 200 r.p.m. and has a linear piston speed of 100 metres per min. If the suction pressure and temperature are 100 kPa and 15‘C respectively and delivery pressure is 1,000 kPa, calculate the dimensions of the compressor cylinder. Assume the law of compression to be $pv^{1.25}$ = constant. Neglect clearance effects.
3. A single-acting, single-stage air compressor is belt driven from an electric motor at 300 r.p.m. The cylinder diameter is 20 cm and the stroke is 24 cm. The air is compressed from one atmosphere to 8 atmospheres and the law of compression is $pv^{1.25}$ = constant. Find the power of the electric motor if the transmission efficiency is 96 per cent and the mechanical efficiency of the compressor is 85 per cent Neglect clearance effect.
4. It is desired to compress 17m^3 of air per minute from 1 bar (100 kN/m2) and 21'C to a delivery pressure of 7 bar (700 kN/m^2) in a single-stage, single-acting air compressor. Calculate the power required to drive the compressor and the heat rejected duhng compression to cooling water if the compression is (a) Isentropic (y = 1.4 for air), and (b) Isothermal.

CO6: Know the mechanism of refrigeration, and its types and different air conditioning system

REMEMBER

1. Define Refrigeration, Refrigerating effect, Tonne of refrigeration and COP.
2. Name the common refrigerants in use.
3. List the desirable properties of a secondary refrigerant.
4. Define Air Conditioning and list the types of air conditioning.
5. Define: Dry air, Saturated air, Dry bulb temperature, Wet bulb temperature, Dew point temperature, Relative humidity, Absolute humidity, Specific humidity.

UNDERSTANDING

1. Explain Vapour compression refrigeration with flow diagram.
2. Explain Vapour absorption refrigeration with flow diagram.
3. Explain the factors affecting the choice of refrigerants commonly used in refrigerating machines.
4. Explain winter Air Conditioning with neat sketch.
5. Explain Summer Air conditioning with neat sketch.
6. Explain Year round air conditioning with neat sketch.

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

	Course Title: **MACHINE DESIGN**		
	Scheme (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15ME53T**
	Type of Course: **Lectures, Self Study & Quiz**	Credit **:04**	Core/ Elective: **Core**
CIE- 25 Marks			SEE- 100 Marks

Prerequisites: Knowledge of Mathematics, Engineering Mechanics, Strength of Materials, Theory of Machines, Machine drawing and Workshop Processes

Course Objectives:

This course curriculum provides the knowledge of design process, as well as enables the student to design simple machine components used in small and medium scale industries.

COURSE OUTCOMES

On successful completion of the course, the students will be able to:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Understand the concept of design and behavior of material under varying load conditions, Use of design data books while designing machine components	***R***	2	**04**
CO2	Design of bolts, nuts, and riveted joints subjected to direct stresses and analyze the type of stresses induced under different load conditions	***R/U/A/An***	1,2	**12**
CO3	Design of machine elements subjected to direct and twisting moments and analyze the type of stresses induced under different load conditions	***U/A***	1,2,	**10**
CO4	Design of machine element like Solid Muff Coupling- flange coupling subjected to direct and twisting moments and Knuckle joint-Cotter joint subjected to direct stress and analyze the various modes of failure(with numeric examples)	***A / An***	1,2	**14**
CO5	Design procedure of machine elements subjected to twisting moment and analyze the type of stresses induced in them	***R/U/A***	1,2	**08**
CO6	Know the Principles of design as per ergonomic, and Environmental considerations	***R/U***	2	**04**
		Total sessions		**52**

Legend: R; Remember, U: Understand A: Application

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
MACHINE DESIGN	**2**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

Unit No	Unit Name	Hour	Questions to be set for SEE/MARKS			Marks weightage	weightage (%)
			R	U	A/An/Ev/cre		
1	INTRODUCTION TO DESIGN	04	05	--	--	05	6.89
2	DESIGN OF FASTENERS	12	05	05	30	40	20.68
3	DESIGN OF SHAFTS, KEYS	10	--	05	15	20	17.27
4	DESIGN OF SIMPLE MACHINE PARTS	14	---	----	50	50	34.48
5	DESIGN OF SPRINGS	08	--	05	15	20	13.79
6	ERGONOMICS & AESTHETIC CONSIDERATION IN DESIGN	04	05	05	--	10	6.89
	Total	**52**	**15**	**20**	**110**	**145**	**100**

UNIT I: INTRODUCTION TO DESIGN 04Hrs

Machine Design–Classification-General considerations-Load-stress-strain,-stress-strain diagram for mild steel- Bending and torsion stress equations - Factor of Safety and Factors governing selection of factor of Safety- Stress Concentration – Causes & Remedies- Designation of materials as per IS- using of design data book – Concept of Theory of failure-types.

UNIT II: DESIGN OF FASTENERS 12Hrs

Stresses in Screwed fasteners- bolts of Uniform Strength- Design of Bolts - Design of studs for cylinder cover-simple problems on design of bolts subjected to external force -Design of Riveted joints -classification- Important terms used in riveted joints-materials for rivets-Failures of riveted joints-Strength and efficiency of riveted joints-Simple problems on Single and Double riveted lap joint -Single and Double riveted Butt joint (with single and double strap)

UNITIII: DESIGN OF SHAFTS, KEYS 10Hrs

Types of Shafts- Shaft materials-Standard Sizes- Design of Shafts (Hollow and Solid) using strength and rigidity criteria-design for line shafts supported between bearings with one or two pulleys in between or one overhung pulley.

Keys-Types-Design of Sunk Keys, Effect of Keyways on strength of shaft-Simple problems (excluding keyways).

UNIT IV: DESIGN OF SIMPLE MACHINE PARTS 14Hrs

Design of Couplings – Solid Muff Coupling- Flange coupling (Protected and Unprotected type) - Cotter Joint - Knuckle Joint

UNIT V: DESIGN OF SPRINGS 08Hrs

Spring – terminology, materials and specifications-Classification and Applications of Springs- Stresses in springs, Wahl's correction factor, Deflection of springs-Design of Helical compression springs subjected to uniform applied loads like I.C. engine valves, weighing balance, railway buffers and governor springs-Problems on helical compression springs only- Leaf springs – Construction and application

UNIT VI: ERGONOMICS & AESTHETIC CONSIDERATION IN DESIGN 4Hrs

Ergonomics of Design-Man-Machine relationship-Equipments for control-Ergonomics considerations in design of controls-Equipments for display-Ergonomics considerations in design of display.-Aesthetic considerations regarding shape, size, color (Morgan's code).

REFERENCES

Sl.No.	Title of Books	Author	Publication
1.	A Text book of Machine Design	R.S. Khurmi & J.K.Gupta	S. Chand publication
2.	Machine design	S G Kulkarni	McGraw Hill Education Publications
3	Introduction to Machine design	V B Bhandari	McGraw Hill Education Publications
4.	Design Of Machine Elements Vol I, Vol II	J.B.K. Das , P.L. Srinivas Murthy	Sapna Publication
5	Machine Component Design	William Orthwein	Jaico publication
6	Design Data Hand Book for Mechanical Engineers	K Mahadevan & K Balaveera Reddy	CBS publications

LIST SOFTWARES/WEBSITES

1. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_home.html
2 http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_mod4.html

3. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_mod7.html .
4. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_mod4.html
5. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_mod5.html
6. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_mod8.html

SPECIAL INSTRUCTIONAL STRATEGIES

UNIT NO	UNIT NAME	STARATEGIES
1	INTRODUCTION TO DESIGN	Lectures, Discussions ,cooperative learning group based learning, Think-Pair-share activities among group of students
2	DESIGN OF FASTENERS	Lectures, discussions, cooperative learning group based learning, Think-Pair-share activities among group of students
3	DESIGN OF SHAFTS, KEYS	Lectures, cooperative learning group based learning, Think-Pair-share activities among group of students
4	DESIGN OF SIMPLE MACHINE PARTS	Lectures, cooperative learning group based learning, Think-Pair-share activities among group of students Industrial visits, movies.
5	DESIGN OF SPRINGS	Lectures, cooperative learning group based learning, Think-Pair-share activities among group of students Industrial visits, movies
6	ERGONOMICS & AESTHETIC CONSIDERATION IN DESIGN	Discussions, real life industries situation, industrial visits

SUGGESTED LIST OF STUDENT ACTIVITYS

Note: the following activities or similar activities for assessing CIE (IA) for 5 marks (Any one)

- Each student should do any one of the following type activity or similar activity related to the course and before take up, get it approved from concerned Teacher and HOD.
- Each student should conduct different activity and no repeating should occur

1	The students should identify at least five applications .He should select the materials for identified applications by using design data hand book. List the mechanical properties of material selected.
2	Observe the system where transmission of power takes place through shaft, Keys, coupling, pulley and belt drive. Get the required information regarding power transmitted (power output by motoror engine etc.). By selecting suitable materials, design the shaft, key and coupling.
3	Assignments on design of Helical Springs, Screwed joints, Riveted joints [one each] with free hand sketches.
4	The student should Download and present various presentations related to design of machine elements
5	The student should Download and present various presentations related to stresses in machine elements.

6	The student should Download and present various presentations related to failure of machine elements.

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	Three IA tests(Average of three tests will be computed)	20	Blue books	1,2,3,4,5,6
				Student Activities	05	Activity sheets	
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

CIE- Continuous Internal Evaluation SEE- Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks evaluated through appropriate rubrics.
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS MODEL

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity.

Note to IA verifier: ***The following documents to be verified by CIE verifier at the end of semester***

4. Blue books (20 marks)
5. Student suggested activities report for 5 marks
6. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Method

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th week of sem 10-11 Am	VSEM	**MACHINE DESIGN**	20
	Year: 2016-17	Course code:15ME53T	

Name of Course coordinator : Units:1,2 Co: 1,2

Note: Answer all questions

Question no	Question	MARKS	CL	CO	PO
1	Define factor of safety. List and explain the factors to be considered while selecting Factor of safety. **OR** Explain stress strain diagram of mild steel is differing from that of cast iron with necessary sketches.	10	R/U	1	2
2	A steam engine cylinder has an effective diameter of 350 mm and the maximum steam pressure acting on the cylinder cover is 1.25 N/mm2. Calculate the number and size of studs required to fix the cylinder cover, assuming the permissible stress in the studs as 33 MPa. **OR** The cylinder head of a steam engine is subjected to a steam pressure of 0.7 N/mm2. It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak-proof. The effective diameter of cylinder is 300 mm. Find the size of the bolts so that the stress in the bolts is not to exceed 100 MPa.	10	A	2	1,2

MODEL QUESTION PAPER (SEE)

V- Semester Diploma Examination		
MACHINE DESIGN		
Time: **3 Hours**]	**Note: Answer all questions**	[Max Marks**: 100**
	PART-A	
1	List the general Considerations in machine design	5
2	Explain man-machine joint system	5
3	List with examples five basic forms for shape of product	5
	PART-B	
4- a	List the different types of riveted joints and rivets.	5
B	Two plates of 10 mm thickness each are to be joined by means of a single riveted double strap butt joint. Determine the rivet diameter; rivet pitch, strap thickness and efficiency of the joint. Take the working stresses in tension and shearing as 80 MPa and 60 MPa respectively.	15
	OR	
4- a	Discuss the stresses induced in the Screw fasteners when it is subjected to static loading.	5
b	The cylinder head of a steam engine is subjected to a steam pressure of 0.7 N/mm2. It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak-proof. The effective diameter of cylinder is 300 mm. Find the size of the bolts so that the stress in the bolts is not to exceed 100 MPa.	15
5- a	Explain the effect of keyway cut into the shaft.	5
b	Select the diameter of a solid steel shaft to transmit 20kw at 200 rpm. The ultimate shear stress for the steel may be taken as 360mpa and factor of safety as 8. If a hallow shaft is to be used in place of solid shaft , finds the inside and outside diameter when the ratio of inside to outside is 0.5.	15
	OR	
5- a	Explain how the shafts are designed when it is subjected to twisting moment only on stiffness/strength basis.	5
b	Select the diameter of a solid steel shaft for a pair of wheels of a railway wagon carries a load of 50KN on each axle box acting at a distance of 100mm outside the wheel base. The gauge of the rails is 1.4 m ,if the stress is not to exceed 100Mpa.	15
6- a	Explain the applications of spring	5
b	Design a close coiled helical compression spring for a service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity, G = 84 kN/mm2. Neglect the effect of stress concentration.	15
	OR	
6- a	Classify the springs.	5
	Design the spring for the buffers of a rail wagon of mass 20 tonnes is	8

b	moving with a velocity of 2 m/s. It is brought to rest by two buffers with springs of 300 mm diameter. The maximum deflection of springs is 250 mm. The allowable shear stress in the spring material is 600 MPa.	15
	PART C	
7	Design a knuckle joint to connect two mild steel bars under a tensile load of 25 kN. The allowable stresses are 65 MPa in tension, 50 MPa in shear and 83 MPa in crushing. **OR**	25
8	Design a rigid flange coupling to transmit a torque of 250 N-m between two coaxial shafts. The shaft is made of alloy steel, flanges out of cast iron and bolts out of steel. Four bolts are used to couple the flanges. The shafts are keyed to the flange hub. The permissible stresses are given below: Shear stress on shaft =100 MPa Bearing or crushing stress on shaft =250 MPa Shear stress on keys =100 MPa Bearing stress on keys =250 MPa Shearing stress on cast iron =200 MPa Shear stress on bolts =100 MPa	25

MODEL QUESTION BANK

V- Semester Diploma Examination

MACHINE DESIGN

Note: ***The paper setter is of liberty to set the questions on his/her desecration based on cognitive levels notified for that unit. They have to follow only blue print of SEE question paper format. The model question bank is only for reference to students/course coordinator to initiate the process of teaching-learning only.***

CO-1: Understand the concept of design and behaviour of material under varying load conditions, Use of design data books while designing machine components

Remember

1) Define machine Design.
2) List out the classification of machine design.
3) List general considerations in machine design.
4) Define the following terms a) Load b) Stress c) strain
6) Define factor of safety.
7) Recall the equation for bending.
8) Recall the equation for Torsion.
9) List the various factors to be considered in deciding the factor of safety.
10) Label the salient features of stress- strain diagram for mild steel.
11) List the different types of failure theories.

CO-2: **Design of bolts, nuts, and riveted joints subjected to direct stresses and analyze the type of stresses induced under different load conditions**

Remember

1. Define fastener.
2. Define Riveted joint.
3. List the different types of riveted joints and rivets.
4. Define efficiency of riveted joint.

Understanding

1. Classify the fasteners.
2. Compare Bolt, stud and Nut.
3. Explain bolt of uniform strength. Where it is preferably used.
4. Explain the stresses induced in the Screw fasteners when it is subjected to static loading.
5. Interpret the reasons for "Initial tightening of bolts is essential".
6. Interpret the reasons for "Excessive tightening of bolts is avoided".
7. Explain the necessity of riveted joint.

8. List the applications of riveted joint in modern equipments.
9. Explain the types of failures in riveted joint with sketch.

a. Problems on bolts

Analysis/Application

1. A steam engine cylinder has an effective diameter of 350 mm and the maximum steam pressure acting on the cylinder cover is 1.25 N/mm2. Calculate the number and size of studs required to fix the cylinder cover, assuming the permissible stress in the studs as 33 MPa.

2. A mild steel cover plate is to be designed for an inspection hole in the shell of a pressure vessel. The hole is 120 mm in diameter and the pressure inside the vessel is 6 N/mm2. Design the cover plate along with the bolts. Assume allowable tensile stress for mild steel as 60 MPa and for bolt material as 40 MPa.

3. The cylinder head of a steam engine is subjected to a steam pressure of 0.7 N/mm2. It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak-proof. The effective diameter of cylinder is 300 mm. Find the size of the bolts so that the stress in the bolts is not to exceed 100 MPa.

4. An eye bolt is to be used for lifting a load of 60 kN. Find the nominal diameter of the bolt, if the tensile stress is not to exceed 100 MPa. Assume coarse threads.

5. Determine the safe tensile load for bolts of M 20 and M 36. Assume that the bolts are not initially stressed and take the safe tensile stress as 200 MPa.

6. An eye bolt carries a tensile load of 20 kN. Find the size of the bolt, if the tensile stress is not to exceed 100 MPa..

7. An engine cylinder is 300 mm in diameter and the steam pressure is 0.7 N/mm2. If the cylinder head is held by 12 studs, find the size. Assume safe tensile stress as 28 MPa.

B. Problems on rivets

Applications/evaluating/creating

1. A double riveted lap joint with zig-zag riveting is to be designed for 13 mm thick plates. Assume σt = 80 MPa ; τ = 60 MPa ; and σc = 120 MPa. State how the joint will fail and find the efficiency of the joint.

2. Two plates of 10 mm thickness each are to be joined by means of a single riveted double strap butt joint. Determine the rivet diameter; rivet pitch, strap thickness and efficiency of the joint. Take the working stresses in tension and shearing as 80 MPa and 60 MPa respectively.

3. Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 N/mm2. Assume joint efficiency as 75%, allowable tensile stress in the plate 90 MPa ; compressive stress 140 MPa ; and shear stress in the rivet 56 MPa.

4. A single riveted lap joint is made in 15 mm thick plates with 20 mm diameter rivets. Determine the strength of the joint, if the pitch of rivets is 60 mm. Take σt = 120 MPa; τ = 90 MPa and σc = 160 MPa.

5. Two plates 16 mm thick are joined by a double riveted lap joint. The pitch of each row of rivets is 90mm. The rivets are 25 mm in diameter. The permissible stresses are as +follows: σt = 140 MPa ; τ = 110 MPa and σc = 240 MPa Find the efficiency of the joint.

6. A single riveted double cover butt joint is made in 10 mm thick plates with 20 mm diameter rivets
with a pitch of 60 mm. Calculate the efficiency of the joint, if σt = 100 MPa ; τ = 80 MPa and σc = 160 MPa.

7. A double riveted double cover butt joint is made in 12 mm thick plates with 18 mm diameter rivets. Find the efficiency of the joint for a pitch of 80 mm, if σt = 115 MPa ; τ = 80 MPa and σc = 160 MPa.

CO-3: Design of machine elements subjected to direct and twisting moments and analyzes the type of stresses induced under different load conditions

Understand

1) Explain the effect of keyway cut into the shaft.
2) List the reasons for rectangular keys are preferred over square keys.
3) Explain how the shafts are designed when it is subjected to twisting moment only on stiffness/strength basis.
4) Explain how the shafts are designed when it is subjected to Bending moment only on stiffness/strength basis.
5) Explain how the shafts are designed when it is subjected to combined twisting moment and bending moment on stiffness/strength basis.
6) List the properties of materials used for shafts.
7) Classify Sunk keys.
8) List he standard sizes of Transmission shafts.
9) Explain how the shafts are designed on Rigidity basis.

Problems on shafts

Applications

1) Select the diameter of the shaft for a mild steel rotating at 200 rpm, transmiting 20kW with a allowable shear stress of 42MPa.

2) Select the diameter of the shaft for a mild steel rotating at 240rpm, is transmitting 1 MW The maximum torque transmitted exceeds the mean torque by 20%. The allowable shear stress as 60mpa.

3) Select the diameter of a solid steel shaft to transmit 20kw at 200 rpm. The ultimate shear stress for the steel may be taken as 360mpa and factor of safety as 8. If a hallow shaft is to be used in place of solid shaft , finds the inside and outside diameter when the ratio of inside to outside is 0.5.

4) Select the diameter of a solid steel shaft for a pair of wheels of a railway wagon carries a load of 50KN on each axle box acting at a distance of 100mm outside the wheel base. The gauge of the rails is 1.4 m ,if the stress is not to exceed 100Mpa.

5) Select the diameter of a solid steel shaft is subjected to bending moment of 3000N-m and a torque of 10000N-m. The shaft is made of 45 c 8 steel having ultimate tensile stress of 700Mpa and Ultimate shear stress of 500Mpa. Assuming factor of safety as 6.

6) Select the diameter of a solid steel shaft made of mild steel is required to transmit 100 kW at 300 r.p.m. The supported length of the shaft is 3 metres. It carries two pulleys each weighing 1500 N supported at a distance of 1 metre from the ends respectively. Assuming the safe value of stresses

7) Select the diameter of a solid steel shaft by considering two different theories of failure made of steel of yield strength 700 MPa is subjected to static loads consisting of a bending moment of 10 kN-m and a torsional moment of 30 kN-m. and assuming a factor of safety of 2.

8) Choose the outside and inside diameter of a hollow steel shaft transmits 600 kW at 500 r.p.m. The maximum shear stress is 62.4 MPa. The outer diameter is twice of inside diameter, assuming that the maximum torque is 20% greater than the mean torque.

Problems on keys

Application/Evaluation

1) Recommend the rectangular key for a shaft of 50 mm diameter. The shearing and crushing stresses for the key material are 42 MPa and 70 MPa.

2) Recommend the required length of key, if the shaft is loaded to transmit the maximum permissible torque. Use maximum shear stress theory and assume a factor of safety of 2 for a 45 mm diameter shaft is made of steel with a yield strength of 400 MPa. A parallel key of size 14 mm wide and 9 mm thick made of steel with a yield strength of 340 MPa is to be used.

3) A 15 kW, 960 r.p.m. motor has a mild steel shaft of 40 mm diameter and the extension being 75 mm. The permissible shear and crushing stresses for the mild steel key are 56 MPa and 112 MPa. Design the keyway in the motor shaft extension. Check the shear strength of the key against the normal strength of the shaft.

4) Select the length of a 20 mm wide key required to mount a pulley on the shaft so that the stress in the key does not exceed 42MPa. A shaft 80 mm diameter transmits power at maximum shear stress of 63 MPa.

5) Select the dimensions of the key so that A shaft 30 mm diameter is transmitting power at a maximum shear stress of 80 MPa. If a pulley is connected to the shaft by means of a key, the stress in the key is not to exceed 50 MPa and length of the key is 4 times the width.

6) Select a suitable key for the gear having a steel shaft has a diameter of 25 mm. The shaft rotates at a speed of 600 r.p.m. and transmits 30 kW through a gear. The tensile and yield strength of the material of shaft are 650 MPa and 353 MPa respectively. Take a factor of safety 3. Assume that the key and shaft are made of the same material.

CO-4: Design of machine element like Solid Muff Coupling- flange coupling subjected to direct and twisting moments and Knuckle joint-Cotter joint subjected to direct stress and analyze the various modes of failure(with numeric examples)

Apply/ Analysis

Muff coupling

1) Design a muff coupling which is used to connect two steel shafts transmitting 40 kW at 350 r.p.m. The material for the shafts and key is plain carbon steel for which allowable shear and crushing stresses may be taken as 40 MPa and 80 MPa respectively. The material for the muff is cast iron for which the allowable shear stress may be assumed as 15 MPa.

2) Design a muff coupling to connect two shafts transmitting 40 kW at 120 r.p.m. The permissible shear and crushing stress for the shaft and key material (mild steel) are 30 MPa and 80 MPa respectively. The material of muff is cast iron with permissible shear stress of 15 MPa. Assume that the maximum torque transmitted is 25 per cent greater than the mean torque.

Problems on flange coupling

Apply/ Analysis

1) Design a cast iron protective type flange coupling to transmit 15 kW at 900
r.p.m. from an electric motor to a compressor. The service factor may be assumed as 1.35. The
Following permissible stresses may be used :
Shear stress for shaft, bolt and key material = 40 MPa
Crushing stress for bolt and key = 80 MPa
Shear stress for cast iron = 8 MPa
2) Design a protective type of cast iron flange coupling for a steel shaft
transmitting 15 kW at 200 r.p.m. and having an allowable shear stress of 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14 MPa.

3) Design a cast iron flange coupling for a mild steel shaft transmitting 90 kW at 250 r.p.m. The allowable shear stress in the shaft is 40 MPa and the angle of twist is not to exceed 1° in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30 MPa.

4) Design a rigid flange coupling to transmit a torque of 250 N-m between two coaxial shafts. The shaft is made of alloy steel, flanges out of cast iron and bolts out of steel. Four bolts are used to couple the flanges. The shafts are keyed to the flange hub. The permissible stresses are given below:

Shear stress on shaft =100 MPa
Bearing or crushing stress on shaft =250 MPa
Shear stress on keys =100 MPa
Bearing stress on keys =250 MPa
Shearing stress on cast iron =200 MPa
Shear stress on bolts =100 MPa

5) Two 35 mm shafts are connected by a flanged coupling. The flanges are fitted with 6 bolts on 125 mm bolt circle. The shafts transmit a torque of 800 N-m at 350 r.p.m. For the safe stresses mentioned below, calculate 1. diameter of bolts ; 2. thickness of flanges ; 3. key dimensions ;4. hub length; and 5. power transmitted.
Safe shear stress for shaft material = 63 MPa
Safe stress for bolt material = 56 MPa
Safe stress for cast iron coupling = 10 MPa
Safe stress for key material = 46 MPa

Problems on cotter joint

Apply/ Analysis

1. Design a cotter joint to connect two mild steel rods for a pull of 30 kN. The maximum permissible stresses are 55 MPa in tension; 40 MPa in shear and 70 MPa in crushing. Draw a neat sketch of the joint designed.

2.Two rod ends of a pump are joined by means of a cotter and spigot and socket at the ends. Design the joint for an axial load of 100 kN which alternately changes from tensile to compressive. The allowable stresses for the material used are 50 MPa in tension, 40 MPa in shear and 100 MPa in crushing.

3. Two mild steel rods 40 mm diameter are to be connected by a cotter joint. The thickness of the cotter is 12 mm. Calculate the dimensions of the joint, if the maximum permissible stresses are: 46 MPa in tension ; 35 MPa in shear and 70 MPa in crushing.

4. Design a cotter joint to support a load varying from 30 kN in compression to 30 kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically. Tensile stress = compressive stress 50 MPa ; shear stress 35 MPa and crushing stress= 90 MPa.

Problems on Knuckle Joint

Apply/ Analysis

1. Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression.

2. Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 70 kN. The ultimate strength of the material of the rod against tearing is 420 MPa. The ultimate tensile and shearing strength of the pin material are 510 MPa and 396 MPa respectively. Determine the tie rod section and pin section. Take factor of safety = 6.
3. Design a knuckle joint to connect two mild steel bars under a tensile load of 25 kN. The allowable stresses are 65 MPa in tension, 50 MPa in shear and 83 MPa in crushing.
4. A knuckle joint is required to withstand a tensile load of 25 kN. Design the joint if the permissible stresses are :σt = 56 MPa ; τ = 40 MPa and σc = 70 MPa.

CO-5: Design procedure of machine elements subjected to twisting moment and analyzes the type of stresses induced in them

Remember

1) List the applications of spring
3) List materials used in Springs.
4) Define the terms used in springs.
5) Name the springs used in a) Spring balance b)Ball Pen c) Door Hinges d) Truck Chassis e)Clock

Understand

1) Classify the springs.
2) Explain the significance of Whal's factor
3) Expline the applications of spring
4) List the materials used in Springs.

Problems on springs

Apply/ Analysis

1) Design a close coiled helical compression spring for a service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity, G = 84 kN/mm2. Neglect the effect of stress concentration.

2) Design and draw a valve spring of a petrol engine for the following operating conditions:
Spring load when the valve is open = 400 N
Spring load when the valve is closed = 250 N
Maximum inside diameter of spring = 25 mm
Length of the spring when the valve is open= 40 mm
Length of the spring when the valve is closed= 50 mm
Maximum permissible shear stress = 400 MPa

3) Design the spring for the buffers of a rail wagon of mass 20 tonnes is moving with a velocity of 2 m/s. It is brought to rest by two buffers with springs of 300 mm diameter. The

maximum deflection of springs is 250 mm. The allowable shear stress in the spring material is 600 MPa.
4) Design a helical compression spring for a maximum load of 1000 N for a deflection of 25 mm using the value of spring index as 5. The maximum permissible shear stress for spring wire is 420 MPa and modulus of rigidity is 84 kN/mm2,with considering whal's factor.

CO-6: Know the Principles of design as per ergonomic, and Environmental considerations

Remember

1) Define Ergonomics.
2) List with examples five basic forms for the shape of Product.
3) List the types of controls.
4) List the types of Display.

Understand

1) Explain the relationship between functional requirement and external appearance of the Product.
2) Explain the scope of ergonomics in product design.
3) Explain the meaning of different colors as per morgan's code.
4) Explain man – machine joint system.
5)Explain the ergonomics considerations in design of controls.
6) Explain the ergonomics considerations in design of Display.

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

	Course Title: **MECHATRONICS**		
	Scheme (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15ME54T**
	Type of Course: **Lectures, Self Study & Quiz**	Credit **:04**	Core/ Elective: **Core**
CIE- 25 Marks			SEE- 100 Marks

Prerequisites: Knowledge of Basic Science, Mathematics, Basic Electrical and Electronics Engineering and Mechanical Engineering discipline courses

Course Objectives.

To expose the students in the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical and Electronic Systems

Course out comes

On successful completion of the course, the students will be able to attain CO:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Discuss the importance of mechatronics systems and know the usage of Sensors and Transducers for automation applications	***R/U/A***	2	07
CO2	Acquire the knowledge of combinational and sequential logic circuits	***R/U/A***	2	11
CO3	Know the various electro and mechanical systems available for automation	***R/U/A***	2	06
CO4	Design the Building blocks of Mechanical, Electrical, Fluid and Thermal Systems	***R/U/A***	2	10
C05	Describe the significance of PLC for automation	***R/U/A***	2	11
C06	Know the importance of communication systems and its interface and Design the Mechatronics Systems.	***R/U/A***	2	07
		Total sessions		**52**

Legend: R; Remember, U: Understand A: Application

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
MECHATRONICS	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

Unit No	Unit Name	Hour	Questions to be set for SEE			Marks weightage	weightage (%)
			R	U	A		
1	MECHATRONICS, SENSORS AND TRANSDUCERS	07	05	05	20	30	20.6
2	DIGITAL LOGIC AND DATA PRESENTATION	11	05	05	20	30	20.6
3	ACTUATION SYSTEMS	06	05	05	20	30	20.6
4	SYSTEM MODELS AND CONTROLLERS	10	05	05	20	30	20.6
5	PROGRAMMABLE LOGIC CONTROLLERS	11	-	05	10	15	10.8
6	COMMUNICATION AND DESIGN OF MECHATRONICS SYSTEM	07	-	-	10	10	6.8
	Total	**52**	**20**	**25**	**100**	**145**	**100**

Legend: R; Remember, U: Understand A: Application

UNIT I: MECHATRONICS, SENSORS AND TRANSDUCERS 07 Hrs

Introduction to Mechatronics Systems - Measurement Systems - Control Systems -Sensors and Transducers - Performance Terminology - Sensors for-Displacement, Velocity, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors, Selection of Sensors.

UNIT II: DIGITAL LOGIC AND DATA PRESENTATION 11Hrs

Digital signals-Introduction,-BCD system-Analog and digital signals- Digital to analog conversion.-Logic Gates-,AND-OR-NOT-NAND-NOR-XOR,Applications-Coder-Encoder-Decoder with seven segment display -LCD-(Traffic Light)-Sequential logic-,Flip Flops,-SR, JK, DFlip flops,-Registers- Data presentation system,-Display-Data presentation elements-Types-Printers- Dotmatrix, Laser printer, Data acquisition system, Selection criteria.

UNT III: ACTUATION SYSTEMS 06Hrs

Electrical Actuation Systems - Mechanical Switches - Solid State Switches-Types –Diode-Power MOSFETs - Solenoids - D.C Motors-Basic working principle-Types- A.C Motors-Basic working principle-Types - Stepper Motors- Basic working principle - List Types - Stepper motor specifications
Mechanical Actuation Systems - Ratchet and Pawl - Bearings.

UNIT IV: SYSTEM MODELS AND CONTROLLERS 10Hrs

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems,-Rotational - Translational Systems,-Electromechanical Systems - Hydraulic - Mechanical Systems-Continuous and discrete process Controllers - Control Mode - Digital Controllers - Velocity Control - Adaptive Control.

UNIT V: PROGRAMMABLE LOGIC CONTROLLERS 11Hrs

Introduction to Memories – RAM, ROM, PROM, EPROM, EEPROM, Microprocessor-block diagram-Architecture of 8051, microcontroller- Architecture, pin configuration of Intel 8081, difference between microprocessor and microcontroller. Programmable Logic Controllers - Basic Structure - Input / Output Processing – Programming - ladder diagram - Mnemonics - Timers, Internal relays and counters - Shift Registers - Master and Jump Controls - Data Handling - Analogs Input / Output – Selection of PLC

UNIT VI: COMMUNICATION & DESIGN OF MECHATRONICS SYSTEM 07Hrs

Digital Communication Systems-Centralized, Hierarchical and Distributed Control-Networks-Protocols-Open Systems Interconnection communication model-Communication Interfaces-Possible Design Solutions Case Studies of Mechatronics Systems,-Car Park barrier Systems - Engine Management Systems- Hard disc drive.

TEXT BOOKS AND REFERENCES

Sl.No.	Title of Books	Author	Publication
1.	Mechatronics”	W.Bolton	Pearson education
2.	Mechatronics-Principles, Concepts and Applications	Nitaigour Premch and Mahalik	Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 2006
3	Mechatronics	HMT	Tata McGraw Hill Publishers, New Delhi
4.	Programmable logic controllers	W.Bolton	Pearson education
5	Digital electronics	Flyod	-
6	Exploring PLC with applications	Pradeep Kumar Srivatsava	-

LIST OF SOFTWARE/LEARNING WEBSITES

1. http://www.vlab.com

2. http://www.mtabindia.com
3. http://www.nptel.ac.in

SPECIAL INSTRUCTIONAL STRATEGIES

UNIT NO	UNIT NAME	STARATEGIES
1	MECHATRONICS, SENSORS AND TRANSDUCERS	Lecturer, Demonstration, Video, Presentation
2	DIGITAL LOGIC AND DATA PRESENTATOIN	Lecturer, Demonstration, Video, Presentation
3	ACTUATION SYSTEMS	Discussions, real life industries situation, industrial visits. Expose to various actuation systems
4	SYSTEM MODELS AND CONTROLLERS	Teaching, Presentations, Industrial visits, movies.
5	PROGRAMMING LOGIC CONTROLLERS	Demonstration, Video, Presentation, Industrial Visit, Mini Project
6	COMMUNICATION AND DESIGN OF MECHATRONICS SYSTEM	Discussions, real life industries situation, industrial visits

SUGGESTED LIST OF STUDENT ACTIVITYS

Note: the following activities or similar activities for assessing CIE (IA) for 5 marks (Any one)

1. Each student should do any one of the following type activity or any other similar activity related to the course and before conduction, get it approved from concerned Teacher and HOD.
2. Each student should conduct different activity and no repeating should occur

1	Each group of students Build and operate simple circuit using application of sensor and submit an hand written report
2	Conduct study on real time applications of different type of Sensors-each one from force & torque type, velocity and acceleration type, proximity type, position type and vision type. And submit a hand report on study
3	Each student will give an activity to Prepare simple circuit diagram for given conditions using logic gates.
4	Development of ladder diagram, programming using PLC for a) measurement of speed of a motor b) motor start and stop by using two different sensors c) simulation of a pedestrian traffic controller d) simulation of four road junction traffic controller e) lift / elevator control f) washing machine control g) tank level control h) soft drink vending machine control
6	Take case study on applications of mechatronics systems in nearby industry; submit report on same

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	Three IA tests (Average of three tests will be computed)	20	Blue books	1,2,3,4,5,6
				Student activities	05	Report/Log of activity	
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

CIE- Continuous Internal Evaluation SEE- Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Blue books(20 marks)
2. Student suggested activities report for 5 marks and should be assessed on RUBRICS
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods.

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS MODEL

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity.

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th week of sem 10-11 Am	VSEM	**MECHATRONICS**	20
	Year: 2016-17	Course code:15ME54T	

Name of Course coordinator : Units:1,2 Co: 1,2

Note: Answer all questions

Question no	Question	MARKS	CL	CO	PO
1	Classify the sensors and transducers	5	U	1	2
2	Define the terms: range and span, repeatability, stability, resolution, output impedance OR List the factors for selection of sensors	5	R	1	2
3	Build Decoder with seven segment display	5	A	2	2
4	Make use of sketch explain weighted-resistor DAC OR Make use of sketch explain successive approximation ADC.	5	A	2	2

MODEL QUESTION PAPER (SEE)

Diploma in Mechanical Engineering

V- Semester

MECHATRONICS

Note; Answer 6 questions from part A & Any 7 from Part B

PART-A 6x5=30

1. Explain with a line diagram the function of each element of a measurement system
2. Why T-Flip-Flops are most commonly used in counters?
3. List different data presentation elements
4. Explain Hydrostatic, solid film and boundary layer bearing.
5. Explain briefly Adaptive Control and its three stages of operations.
6. Explain briefly protocols and its elements.
7. List the selection factors of PLC.
8. Explain briefly protocols and its elements.
9. What are the Specifications of stepper motor?
10. List the performance features of sensors and transducers

PART-B 7x10=70

1. Make use of a sketch to explain the working of a diaphragm pressure gauge.
2. Make use of a sketch to explain coded digital signal to a set of Traffic Lights
3. Make use of a sketch to explain the working of Laser printer.
4. Make use of a sketch to explain Zener diode protection circuit
5. Make use of a sketch to explain Digital closed-loop Control system.
6. Make use of a sketch to explain model of building up a thermal system.
7. Make use of a sketch to explain rotary potentiometer.
8. Build a ladder programming and list its sequences with line diagram
9. Explain Continuous and discrete process Control processes.
10. Make use of a sketch to explain design of Car Park barrier System.
11. Explain briefly
    a. Centralized computer control
    b. Hierarchical system
    c. Distributed system

MODEL QUESTION BANK

Diploma in Mechanical Engineering

V Semester

Course Title: MECHATRONICS

CO I. Discuss the importance of mechatronics systems and know the usage of Sensors and Transducers for automation applications

REMEMBER QUESTIONS

1) Define Mechatronics?
2) Define system with example.
3) Define sensors and transducers with an example.
4) List the factors for selection of sensors.
5) Define the terms: range and span, error, accuracy, sensitivity, hysteresis error, non-linearity error, repeatability/reproducibility, stability, dead band/time, resolution, output impedance.
6) List the performance features of sensors and transducers.

UNDERSTANDING QUESTIONS

1) Explain the importance of mechatronics.
2) Explain with a block diagram the measurement system.
3) Explain control systems and their types.
4) Classify the sensors and transducers.
5) Explain sensors for displacement, position and proximity.
6) Explain the working of light sensors.

APPLICATION QUESTIONS

1) Make use of a sketch to explain the working of pneumatic sensors.
2) Build a line diagram and explain the function of each element of a measurement system.
3) Make use of a sketch to explain the working of proximity switches.
4) Make use of a sketch to explain the working of optical encoder.
5) Make use of a sketch to explain the Hall Effect sensors.
6) Make use of a sketch to explain the working of tachogenerator.
7) Make use of a sketch to explain sketch bimetallic strip/thermostat.
8) Make use of a sketch to explain the working of a diaphragm pressure gauge.
9) Make use of a sketch to explain strain gauge load cell.
10) Make use of a sketch to explain piezoelectric sensor.
11) Make use of a sketch to explain turbine meter.
12) Make use of a sketch to explain float type liquid level meter.
13) Make use of a sketch to explain the working of LVDT.
14) Make use of a sketch to explain the bimetallic strips.

CO 2: Acquire the knowledge of combinational and sequential logic circuits

LEVEL: REMEMBER

1) Define analog signal.
2) What are Digital signals?
3) List different data presentation elements.
4) List different printers.
5) List the selection of DAQ criteria.
6) List the Applications of logic gates.

LEVEL: UNDERSTANDING

1) Explain briefly BCD system.
2) Explain briefly various data presentation elements.
3) Explain briefly data acquisition system.
4) Explain display.

LEVEL: APPLICATION

1. Make use of a sketch to explain briefly weighted-resistor DAC
2. Make use of a sketch to explain the successive approximation ADC.
3. Construct the truth table for the following logic gates
    a. AND gate
    b. OR gate
    c. NOT gate
    d. NOR gate.
    e. NAND gate
    f. XOR gate.
4) Make use of a sketch to explain coded digital signal to a set of Traffic Lights.
5) Make use of a sketch to explain sequential logic system.
6) Make use of a sketch to explain following Flipflops.
    a. Flip Flops.
    b. SR.
    c. JK.
    d. D Flip Flops.
    e. Registers.
7) Make use of a sketch to explain dot matrix print head mechanism.
8) Make use of a sketch to explain basic elements of a laser printer.
9) Make use of a sketch to explain Decoder with seven segment display.
10) Make use of a sketch to explain LCD.

C0 03: Know various actuation systems and understand the working of mechanical, electrical, hydraulic actuation systems.

LEVEL: REMEMBER

1) Define a bearing.

2) List the uses of bearings.
3) List all types of bearings.
4) List different types of solid state switches.
5) List Different types of DC motors.
6) List Different types of AC motors.
7) Define stepper motor.
8) List different types of stepper motors.
9) List the terms commonly used for specifying stepper motors.

LEVEL: UNDERSTANDING

1) Explain Hydrostatic, solid film and boundary layer bearing.
2) Explain in brief electrical systems.
3) Explain the terms commonly used for specifying stepper motors.

LEVEL: APPLICATION

1) Make use of a sketch to explain simple sensor actuation system.
2) Make use of a sketch to explain principle of the Ratchet and Pawl.
3) Make use of a sketch to explain basic elements of ball and roller bearings.
4) Make use of a sketch to explain plain journal bearing.
5) Make use of a sketch to explain Hydrodynamic bearing.
6) Make use of a sketch to explain relays.
7) Make use of a sketch to explain diodes.
8) Make use of a sketch to explain MOSFETs.
9) Make use of a sketch to explain solenoids.
10) Make use of a sketch to explain the basic working principle of DC motor.
11) Make use of a sketch to explain the basic working principle of AC motor.

CO 04: Design the Building blocks of Mechanical, Electrical, Fluid and Thermal Systems.

LEVEL: REMEMBER

1) List different Control Modes.

LEVEL: UNDERSTANDING

1) Explain briefly the necessity of mathematical models.
2) Explain electrical system building blocks.
3) Explain thermal system building blocks
4) Explain electromechanical system.
5) Explain hydraulic-mechanical system.
6) Explain Continuous and discrete process Control processes.
7) Explain briefly Control Modes.
8) Explain briefly Adaptive Control and its three stages of operations.

LEVEL: APPLICATION

1) Make use of a sketch to explain different mechanical building block systems like spring, dashpot and mass.
2) Make use of a line diagram to explain model of building up a spring -dashpot-mass mechanical system.
3) Make use of a line diagram to explain model of building up a resister -inductor-capacitor electrical system.
4) Make use of a sketch to explain model of building up a thermal system.
5) Make use of a sketch to explain the rotational-translational system.
6) Make use of a sketch to explain rotary potentiometer.
7) Make use of a sketch to explain hydraulic system and load (without derivation).
8) Make use of a sketch to explain Digital closed-loop Control system.
9) Make use of a sketch to explain Velocity Control.

CO 05: Describe the significance of PLC for automation

LEVEL: REMEMBER

1. List the different types of memories.
2. Define Microprocessor.
3. Define Microcontroller.
4. Define PLC.
5. List Input/output processing.
6. Define counter.
7. List the use of master relay.
8. List the selection factors of PLC.

LEVEL: UNDERSTANDING

1) Classify Memories.
2) Explain the following :
   a. RAM, b. ROM, c. PROM, d. EPROM, e. EEPROM
3) Explain the architecture of Microprocessor.
4) Explain the architecture of microcontroller.
5) Compare Microprocessor and Microcontroller.
6) Explain with sketch architecture of PLC
7) Explain Input/output processing.
8) Explain ladder programming and its sequences with line diagram.
9) Explain ladder program with ladder diagram.
10) Infer the mnemonics used in PLC.
11) Explain shift registers.
12) Explain briefly data handling.

LEVEL: APPLICATION

1) Construct the ladder diagram for following functions.
    a. Delay-on timer
    b. On-delay timer(TON)
    c. Timing with off-delay(TOFF)
2) Construct a ladder diagram for input/output of counters and various ways of representing the same.
3) Construct a PLC ladder diagram for Master Control Relay.
4) Construct a PLC ladder diagram for Jumps.

CO 06: Know the importance of communication systems and its interface and Design the Mechatronics Systems.

LEVEL: REMEMBER

1) List different types of networks.
2) List different types of network layers.

LEVEL: UNDERSTANDING

1) Explain briefly the role of digital communications.
2) Explain briefly
    a. Centralized computer control
    b. Hierarchical system
    c. Distributed system
3) Explain different types of networks.
4) Explain briefly protocols and its elements.
5) Explain briefly the open system interconnection communication model.
6) Explain briefly different network layers.
7) Explain briefly serial and parallel interfaces.

LEVEL: APPLICATION

1. Make use of a neat sketch to explain Car Park barrier System.
2. Make use of a neat sketch to explain of Engine Management Systems.
3. Make use of a neat sketch to explain design of hard disc drive.

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

	Course Title: **PROFESSIONAL PRACTICES (Mechanical Stream)**		
	Scheme (L:T:P) : **0:2:4**	Total Contact Hours: **78**	Course Code:15ME55P
	Type of Course: **Assignment Group talk and practice**	Credit **:03**	Core/ Elective: **Core(practice)**
CIE- 25 Marks			SEE- 50 Marks

Prerequisites: Enthusiasm to Explore New things by taking individual tasks and acquires skills from participating in group activities.

Course Objectives:

Professional development of Diploma engineering students is to be done by exposing them to various simulative situations in the industries. This is achieved by involving students in activities such as inviting experts from various industries for sharing their experiences, arranging industrial visits, seminars etc.

COURSE OUT COME

On successful completion of the course, the students will be able to:

Course Outcome		CL	Linked activity	Linked PO	Teaching Hrs
CO1	Search the information related to topic, and acquire knowledge of contemporary issues related to advancements in Mechanical engineering.	Analysis	1	2,8,9	15
CO2	Exposure to various industry environment practice and global, societal, economic, and/or environmental issues, by listening experts talks and interact with them	Application/ analysis	2	2,7,8,9	15
CO3	Discuss & disseminate about advancements in related profession including societal, environmental	Innovative /Analysis	3	7,8,9	15
CO4	Develop individual confidence and acquire life skills to handle various engineering assignments	Application	4	2,7,8	15
CO5	Enhancing the employability skills and to increase his ability to engage in, life-long learning, by undergoing industrial visits	Analysis /Creation	5	2,4,10	18
		Total			**78**

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
PROFESSIONAL PRACTICES	**0**	**3**	**0**	**1**	**0**	**0**	**2**	**3**	**2**	**1**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

1. Information Search and Data collection: 15HRS

Information search can be done through manufacturer's catalogue, websites, magazines; books etc. *Following topics are suggested.*

1. Engine lubricants & additives
2. Automotive gaskets and sealants
3. Automobile automatic diagnostics
4. Engine coolants and additives
5. Two and Four wheeler carburettor.
6. Power steering
7. Filters
8. Different drives/Transmission systems in two wheelers.
9. Types of bearings – applications and suppliers.
10. Heat Exchangers
11. Maintenance procedure for solar equipment.
12. Tools holder on general purpose machines and drilling machines.
13. The student should search any relevant information of innovation principles should lead to selection of Project in Current semester.
14. Cutting tools
15. Additive manufacturing
16. Alternative materials for manufacturing
17. Composite materials
18. Nano materials
19. Welding in medical applications
20. Micro machining and fabrication
21. Advanced metal casting
22. Special purpose machines
23. Jigs and fixtures
24. Plant maintenance
25. Industrial safety
26. Fire fighting
27. Industrial Effluent treatment
28. Low cost automation

Method for conducting Graded activities

1. The student should individually select the topic, and search the information related to topic.
2. The report is strictly hand written document to have knowledge of precise writing and report making based on data collection

3. Carry out class room presentation.

2. Guest Lecturers: To be organized from any two of the following areas 15 HRS

Experts / Professionals from different field/industries are invited to deliver lectures at least TWO sessions in a semester. The topics may be selected by the teacher /industry expert to develop required skills.

Note: The ISTE student chapter/CCTEK/ Institute of engineers (Institute chapter)/ student clubs of polytechnic may be used as platform to conduct this activity.

1. Pollution control.
2. Non destructive testing.
3. Fire Fighting / Safety Precautions and First aids.
4. Computer Networking and Security.
5. Career opportunities,
6. Yoga Meditation,
7. Aids awareness and health awareness.
8. Use of plastics in automobiles.
9. Nonferrous Metals and alloys for engineering applications
10. Surface Treatment Processes like electroplating, powder coating etc.
11. Computer aided drafting.
12. Industrial hygiene.
13. Composite Materials.
14. Heat treatment processes.
15. Ceramics
16. Safety Engineering and Waste elimination
17. Interview Techniques.
18. Alternate fuels – CNG / LPG , Biodiesel, Ethanol, hydrogen
19. Piping technology
20. Electronic fuel injection systems
21. Exhaust gas analysis.
22. Vehicle testing.
23. Environmental pollution & control.
24. Vehicle aerodynamics & design.
25. Earth moving machines.
26. Biotechnology
27. Nanotechnology
28. Rapid prototyping
29. Programmable logic controllers
30. TQM
31. MPFI
32. Hybrid motor vehicles
33. Packaging technology
34. Cloud computing
35. Expert systems

Method for conducting Guest lectures

1. The teacher/ISTE student chapter convener should fix up the date for guest lecture
2. The HOD of the department should chair the event
3. The students of class allowed to participate in the session

4. Watch the talk and make the brief hand written report on the guest lecture delivered by each student as a part of Term work.
5. Make Audio/visual record of the guest lecture by using any smart devices
6. Opportunity should be provided for students for live Interaction with experts and record it on any one smart device.

3. Group Discussion: (One topic) 15HRS

The students shall discuss in group of six students .Some of the suggested topics are

1. Polythene bags must be banned!
2. Do we really need smart cities?
3. E – Books or Printed books – what's your choice?
4. Is Face book for the attention – seeking and lazy people?
5. Globalization and its impact on Indian Culture.
6. Analytically evaluate the solutions to traffic problems
7. Global warming is caused more by developed countries
8. Rain forests help in maintaining the earth's ecosystem
9. Reservation for women would help the society
10. How to deal with terrorism
11. Water resources should be nationalized
12. Daughters are more caring than sons
13. NGOs - Do they serve people's interests?
14. Managers are born, not trained
15. Managerial skills learnt in the classroom
16. Women are good managers
17. India's growth rate is bridging gap between rich and poor.
18. Nuclear power is a safe source of energy
19. Electronic media vs. print media
20. Corruption is the price we pay for democracy
21. Multinational corporations: Are they devils in disguise?
22. Advertising is a waste of resources.
23. Privatization will lead to less corruption.
24. China market - a threat to Indian market
25. Technology Creates Income Disparities
26. India should be reorganized into smaller states.
27. Rising petrol prices - Govt. can control?
28. Smaller businesses and start-ups have more scope
29. Developing countries need trade, not aid.
30. Business and Ethics do not go together
31. Performance based bonuses for government employees should be welcomed
32. Depreciation of Indian Rupee has only negative impact on the economy
33. Gold: Best investment or a bursting bubble?
34. Freedom of press should exist
35. India needs a strong dictator
36. Media is a mixed blessing/How ethical is media?
37. Computer viruses are good
38. India should practice "Swadeshi"
39. The government should stop funding IIT's and IIM's
40. Food Bill - Is it really something India needs?
41. Will India really be the superpower of 21st century?

42. Quality is a myth in India.
43. China - A threat to India?
44. Indian villages - our strength or our weakness?
45. Mobile phones - requirement of the day.
46. Cursing the weather is bad farming
47. If you want peace, prepare for war
48. Education is a progressive way of discovering your ignorance.
49. Beauty contests degrade womanhood
50. If you are not a part of the solution, you are part of the problem
51. Examinations - has it killed education?
52. The medium of teaching in schools should be English
53. A room without books is like a body without soul.
54. Educated Indians lack national commitment.
55. E-Learning is good for the education system and society

Methodology for conducting Group discussion/Seminar

1. The teacher will allot a topic for a group of six students
2. The teacher should give an introductory talk on Ways and rules to carry out group discussion
3. The students should ask to show interest with others and work effectively with them to meet common objective. The teacher should provide tips to accept feedback in a constructive and considerate way and how to handle frustrations in group, while discussion.
4. The placement officer and any other senior faculty of the institute/ HOD of other department should be invited and they should act as observing members, apart from teacher
5. The teacher should fix up the time duration for initiating and conducting the activity

6. **Documentation to be produced for validation**
   - Hand written document on minutes of discussion, description of the topic discussed
   - Record the few minutes of discussion by smart device

4. Individual Assignments and Life skills 15HRS

The students will perform ANY ONE of the following activities individually (other similar activities may be considered) in both the sections

A. Individual assignments

1. Collecting Failure data for automobile / machines / equipment.
2. Study of Hydraulic system for any one application like – dumpers, Earth moving equipment, Auto service station.
3. Survey of oils used for hydraulic circuits – specifications, properties, costs, manufacturers names etc.
4. Study any one type of CNC machining centre and prepare report on tooling and tool holding devices
5. For a given job write a sequence of operations performed by automated manufacturing system. Draw a block diagram of control system to perform above operations
6. Survey of types of bearings involving information about construction working principles, mounting, lubrication, materials, advantages, limitations and cost.

7. Prepare a trouble shooting chart for any refrigeration system and suggest remedial measures to avoid failures
8. For a drilling or milling operations on a simple machine component,
9. Draw a jig or fixtures showing various features like locating clamping, fool proofing etc.
10. Compare non traditional methods on the basis of working principles, accuracy , MRR, Applications and limitations a) EBM b) PAM C)AJM d)WJM

B. Life skills

1. Conduct aptitude, general knowledge test, IQ test, Solve Puzzles.
2. Set the goal for personal development.
3. Develop good habits to overcome stress.

Methodology for conducting activity

1. The teacher will assign a topic for individual student; give sufficient time to complete the task. Ask the student to submit an hand written report
2. The teacher should conduct any one specified life skill activity with local NGO/ placement cell/ISTE student chapter/CCTEK/ NSS unit of the institute. The student should present his/her experiences in a class and make report.

5. Industrial Visits 18HRS

Structured industrial visits be arranged and report of the same shall be submitted by the individual student, to form a part of the term work. Following are the suggested types of Industries/ Fields.
Note: One Industrial visit is arranged per practical batch of students.

1. Automobile manufacturing / press component / auto component manufacturing units to observe the working of SPM / Non Conventional Manufacturing process / CNC / FMS / Robots
2. Refrigeration and air conditioning manufacturing / servicing units
3. Industries
4. State transport depot/workshops
5. Automobile service stations for four wheelers/Wheel Balancing unit for light and/or heavy motor vehicles/exhaust gas analysis and vehicle testing / ST workshop.
6. Co-ordinate measuring machine to observe its construction working specifications and applications. Engine Testing unit to gather details regarding the testing procedures/parameters etc.
7. Food processing/ Dal mill/ Oil Mill/ Automated bakery unit.
8. Textile industry / Textile machinery manufacturing / garment manufacturing /embroidery / textile printing and dying units.
9. Hydro electric and Thermal power plants.
10. Tyre retreading, paint manufacturing, foundries, forging unit, heavy fabrication unit, steel and wooden furniture/Toys manufacturing/Agricultural equipment manufacturing units.
11. Hardware and Machinery stores selling agro equipment
12. Plastic injection moulding, extrusion, blows moulding.
13. Stone crushers / hot mix plant/ service stations of JCBs and other earthmoving equipment

M Methodology for conducting activity

1. The subject teacher(s) have liberty to select nearby organization/industry of local vicinity with prior approval of principal of the institute
2. Arrange the nearby visit and Prepare a word processing report of the visit including details observations made, Details of visit should be mentioned with date , place etc

Course Delivery:

The course will be delivered through discussions and activities

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment meth	CIE	IA	Students	Each activities @5 marks each	25	Report	1,2,3,4,5
				End of the course	50	Answer scripts at BTE	1,2,3,4,5
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Student activities report for25 marks
2. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods.

For end examination:

1. **Note for examiners : The records of the activities should be preserved in the department for minimum three years and the examiner should verify these records to prevent duplication of the activity**

Scheme of Valuation for End Examination

Serial no	Description	Marks
1	**Report and presentation on Information Search and Data collection**	10
2	**Document on Guest Lecturer by experts**	10
3	**Recording of Group discussions made by any smart devices**	10
4	**Report on Individual assignment/ Life skill activity recorded**	10
5	**Report on Industrial visit**	10
	TOTAL	**50**

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfil team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity

MODEL QUESTION PAPER

- Semester Diploma Examination

Course Title: **PROFESSIONAL PRACTICES**

Time: **3 Hours**] [Max Marks**: 50**

1.	Write brief note on information searched and data collected activity	10marks
2.	Give brief explanation about knowledge acquired by you during the guest lecture	10 marks
3.	Write the conclusion of the topic given for the group discussion	10 marks
4.	Write brief note on individual assignment performed and information gathered and data collected activity	10marks
5.	Write the sequence of processing followed in the industry/work shop You have visited	10 marks

Note: The marks should be awarded on the basis of Reports/Documents submitted by the student

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

	Course Title: **THERMAL ENGINEERING LAB**		
	Scheme (L:T:P) : **0:2:4**	Total Contact Hours: **78**	Course Code: **15ME56P**
	Type of Course: **Tutorial and practice**	Credit **:03**	Core/ Elective: **Core(practice)**
CIE- 25 Marks			SEE- 50 Marks

Prerequisites: Learning concepts of Basic and applied Thermal engineering

Course Objectives:

By undergoing this lab the students will get enough confident about all the types of IC engines parts, so that they can rectify some sort of problems normally occurring in their automobiles.

COURSE OUT COMES

On successful completion of the course, the students will be able to attain CO:

Course Outcome		CL	Linked experiments	Linked PO	Teaching Hrs
CO1	Appreciate the practical ways to find calorific values of fuel	***U/A***	01	2,3	**06**
CO2	Understand the various components and mechanisms of I. C. Engines. Appreciate the Mechanism of ports /Valves functioning in 2-stroke petrol /Diesel engine	***U/A***	2,3 & 13,14	2,3	**24**
CO3	Evaluating the performance characteristics of single cylinder petrol engine at different loads and single cylinder diesel engine at different loads and draw the heat balance sheet	***U/A***	4,5,6,7	2,3	**24**
CO4	Understand the method of finding the indicated power of individual cylinders of an engine by using morse test	***U/A***	8	2,3	**06**
C05	Understand the method of evaluating the co efficient of performance of refrigerator	***U/A***	9	2,3	**06**
CO6	Understand the method of finding the thermal conductivity of material	***U/A***	10,11,12	2,3	**12**
		Total sessions			**78**

Legend U; Understand A; Application

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
THERMAL ENGINEERING LAB	**0**	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.
Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

LIST OF GRADED PRACTICAL EXERCISES

The practical/Graded exercises should be properly designed and implemented with an attempt to develop different types of learning out comes in affective domain and psychomotor domain, so that students are able to acquire the necessary skills. Following is the list of experiments to be carried out.

Exercise No.	Practical/Exercise	Apprx. Hrs. Required
PART A. PERFORMING EXPERIMENTS		
1	Determination of calorific value of liquid and gaseous fuel by using Bomb calorimeter /Boy's gas calorimeter	06
2	Draw the valve timing diagram of 4-stroke diesel engine	06
3	Plot the performance characteristics of single cylinder diesel engine for different loads	06
4	Draw the heat balance sheet of single cylinder diesel engine	06
5	Plot the performance characteristics of single cylinder petrol engine for different loads	06
6	Find the indicated power of individual cylinders of an engine by using MORSE test	06
7	Determine the volumetric efficiency of air compressor	06
8	Determine the co efficient of performance of refrigerator	06
9	Determine thermal conductivity of thick slab	06
10	Determine thermal conductivity of composite wall	03
11	Determine thermal conductivity of thick cylinder	03
PART- B. STUDY EXPERIMENTS		
13	Study of I.C. Engine parts (Cylinder block, head, piston and piston ring Connecting rod& crank shaft , spark plug, Carburettor, fuel injector and fuel pump	06
14	Study of Differential, rear axle and power steering mechanism	06
15	Case study on Dismantling and assembly of engines	06
	TOTAL	**78**

Elements of Thermal Engineering by R.S.Khurmi/ Rajputh

Automobile Engg by kirpal Singh (Vols. 1 and II)

SUGGESTED STUDENT ACTIVITY

1. Each student should submit any one of the following type activity or any other similar activity related to the course and before take up get it approved from concerned Teacher and HOD.
2. Each student should conduct different activity and no repeation should occur

1	Collect/ download product catalogues with specification of various types of energy conservation equipment/ devices and heat exchanger of recent trends.
2	Identify and list at least 10 equipments/devices which require heat transfer and prevention of heat transfer. Also state mode of heat transfer and methods used to prevent heat transfer.
3	At least one visit of any power plant/ industry where various items like air compressor, heat exchanger, cooling tower, condenser etc. can be shown to students.

Course Assessment and Evaluation Scheme:

Method	**What**		**To whom**	**When/Where (Frequency in the course)**	**Max Marks**	**Evidence collected**	**Course outcomes**
DIRECT ASSESSMENT	**CIE** (Continuous Internal Evaluation)	**IA** Tests	Students	Two Tests (Average of two tests to be computed)	10	Blue books	1,2,3,4,5,6
				Record Writing (Average marks of each exercise to be computed)	10	Record Book	1,2,3,4,5,6
				Activity	05	Report	1,2,3,4,5,6
				TOTAL	25		
	SEE (Semester End Examination)	End Exam		End of the course	50	Answer scripts at BTE	1,2,3,4,5,6
INDIRECT ASSESSMENT	Student Feedback on course		Students	Middle of the course		Feedback forms	1, 2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3, 4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

***CIE** – Continuous Internal Evaluation ***SEE** – Semester End Examination

Note:

1. I.A. test shall be conducted as per SEE scheme of valuation. However obtained marks shall be reduced to 10 marks. Average marks of two tests shall be rounded off to the next higher digit.
2. Rubrics to be devised appropriately by the concerned faculty to assess Student activities.
3. Student suggested activities report for 5 marks
4. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

EQUIPMENT LIST

Serial no	Description	Quantity
1	Bomb calorimeter	1
2	Boys gas calorimeter	1
3	2- Stroke , Single- Cylinder petrol engine test rig	1
4	4 –Stroke , Multi cylinder petrol engine test rig(Morse test)	1
5	4 – Stroke , Single cylinder diesel engine test rig with Exhaust Gas Calorimeter	1
6	2 Stage reciprocating air compressor	1
7	Refrigeration unit	1
8	Thermal Conductivity Apparatus- Thick slab	1
9	Thermal Conductivity Apparatus- Composite wall	1
10	Thermal Conductivity Apparatus- Thick cylinder	1
11	Cut section models – petrol engine and diesel engine	2
12	I.C engine models	1

Scheme of Valuation for End Examination

Serial no	Description	Marks	
1	**Part A** **Writing procedure**	10	**35**
	Conducting of Experiment :)Major Experiment(Group of Five)	10	
	Calculation, results, Inference	15	
2	**Part B (Study experiment)** **One question to be asked to explain (with sketch) any one component.**		**10**
3	**Viva**		**05**
TOTAL			**50**

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

Course Title: **MECHATRONICS LAB**		
Scheme (L:T:P) : **0:2:4**	Total Contact Hours: **78**	Course Code: **15ME57P**
Type of Course: **Tutorial and practice**	Credit **:03**	Core/ Elective: **Core (practice)**
CIE- 25 Marks		SEE- 50 Marks

Prerequisites: Mechatronics

Course Objectives:

1. To expose the students in Fluid power circuits, PLC based Fluid Power Control, Actuators, controllers and Virtual Instrumentation.

Course out comes

On successful completion of the course, the students will be able to attain CO:

Course Outcome		CL	Linked experiments	Linked PO	Teaching Hrs
CO1	Understand the digital logic	***U/A***	1	2,3,4	**24**
CO2	Understand the concept of interfacing the various mechanical, electrical, electronics and computer systems	***U/A***	1,2,3,4,5,6,7	2,3,4	**15**
CO3	Know about the details of hydraulic and pneumatic Systems.	***U/A***	1,2,3,4,5,6,7	2,3,4	**30**
CO4	Design the circuits for hydraulic and pneumatic systems with PLC control	***U/A***	1,2,3,4,5,6,7	2,3,4	**15**
				Total sessions	**78**

Legend: R: remember U: Understand A: Application

Course –PO matrix

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
MECHATRONICS LAB	**0**	**1**	**3**	**2**	**0**	**0**	**0**	**0**	**0**	**0**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.
Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

LIST OF GRADED PRACTICAL EXERCISES

The practical/Graded exercises should be properly designed and implemented with an attempt to develop different types of learning out comes in affective domain and psychomotor domain, so that students are able to acquire the necessary skills. Following is the list of experiments to be carried out.

Exercise No.	Practical/Exercise	Apprx. Hrs. Required
PART A. PERFORMING EXPERIMENTS		
1	Design and Simulate the following digital circuits using MultiSim/any digital circuit simulator. Basic Logic Gates (i) Basic Logic Gates (ii) Demorgan's Theorem (iii) Combination Logic (iv) Encoders and Decoders (v) Flip-Flops	18
PART B. PERFORMING EXPERIMENTS (PLC)		
1	1. Draw the ladder rungs to represent i. Two switches Normally Open and both have to be closed for the motor to operate. ii. Either of the two Normally Open switches to be closed for the coil to be energised	09
2.	Devise a timing circuit that will switch on for 20s and then switch it off.	06
3	Device a timing circuit that will switch on 10s and off 20s and so on	06
4	Device a circuit that can be used to start a motor and then to start a pump after delay of 50s. Then the motor is switched off 10s before the pump is switched off when the pump remains on for 50s.	09
5	Devise a circuit that can be used with the domestic washing machine to switch on a pump to pump water for 100s into the machine. Then switch on a heater for 50s to heat the water. The heater is switched off and another pump is switched on to empty the water for 100s.	09
6	Design and simulate of fluid power circuits to control (i)velocity (ii) direction of a single and double acting actuators	09
7	Design and Simulate a ladder diagram for car parking. (Hint: car is to be detected and enter the parking space to a particular location if space is available. If there is no space, a lamp should indicate that parking is full.)	09
	TOTAL	**78**

TEXT BOOKS AND REFERENCES

Sl.No.	Title of Books	Author	Publication
1.	Mechatronics	W.Bolton	Pearson education
2.	Mechatronics-Principles, Concepts and Applications	Nitaigour Premch and Mahalik	Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 2006
3	Mechatronics	HMT	Tata McGraw Hill Publishers, New Delhi

4.	Programmable logic controllers	W.Bolton	Pearson education
5	Digital electronics	Flyod	-
6	Exploring PLC with applications	Pradeep Kumar Srivatsava	BPB publications

SUGGESTED LIST OF STUDENT ACTIVITYS

1. Each student should submit any one of the following type activity or any other similar activity related to the course and before take up get it approved from concerned Teacher and HOD.
2. Each student should conduct different activity and no repeation should occur

1	Visit to any of the nearest Electo-mechnaical based industries and the get report related to Mechanical operation performing using PLC and microcontroller.
2	Visit any of the nearest local service centre of automated Domestic washing machine get the information in the form report.(Make the Video when it is dismantled for presentation)
3	Visit the electrical and electronics laboratory and submit the report on construction and working of stepper motor when it is interfaced with any of the micro controller.

Course Delivery:

The course will be delivered through Demonstration and Shop practices

Course Assessment and Evaluation Scheme:

Method	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
DIRECT ASSESSMENT	**CIE** (Continuous Internal Evaluation)	**IA** Tests	Students	Two Tests (Average of two tests to be computed)	**10**	Blue books	1,2,3,4
				Record Writing (Average marks of each exercise to be computed)	**10**	Record Book	1,2,3,4
				Activity	**05**	Report	1,2,3,4
				TOTAL	**25**		
	SEE (Semester End Examination)	End Exam		End of the course	**50**	Answer scripts at BTE	1,2,3,4
INDIRECT ASSESSMENT	Student Feedback on course		Students	Middle of the course		Feedback forms	1, 2 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3, 4 Effectiveness of Delivery of instructions & Assessment Methods

Note: *CIE – Continuous Internal Evaluation ***SEE** – Semester End Examination

Note:

1. I.A. test shall be conducted as per SEE scheme of valuation. However obtained marks shall be reduced to 10 marks. Average marks of two tests shall be rounded off to the next higher digit.
2. Rubrics to be devised appropriately by the concerned faculty to assess Student activities.
3. Student suggested activities report for 5 marks
4. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

MODEL OF RUBRICS FOR ASSESSING STUDENT ACTIVITY

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfil team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

5. Blue books (10 marks)
6. Student suggested activities report for 5 marks
7. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

SCHEME OF VALUATION			
Serial no	**Description**	**Marks**	
1	**Part A** **Writing**	5	**15**
	Execution	10	
2	**Part B** **Writing**	10	**25**
	Execution	15	
3	**Viva**		**10**
		TOTAL	**50**

SYSTEM REQUIREMENTS

1. Computers with latest configurations-cpu-3.0GHz-RAM-2Gb/hdd-250Gb/dedicated graphics card1Gb
2. UPS-minimum 7.5 KvA
3. LCD projector-2 Nos.

SOFTWARE REQUIREMENTS

1. **MultiSim– Latest version with 20 user Licences**
2. **PLC – trainer Kit-5 nos each (Siemens/Allen Bradley/Keyence/Fanuc)**

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

	Course Title: **PROJECT WORK-I(Mechanical Stream)**		
	Scheme (L:T:P) : **0:1:2**	Total Contact Hours: **39**	Course Code: 15ME58P
	Type of Course: **Practice**	Credit **:-**	Core/ Elective: **Practice**
CIE- 25 Marks			

Prerequisites: Application learned concepts form the previous semester studied courses.

Course Objectives:

1. Learn the objective of this project is to provide opportunity for the students to implement their skills acquired in the previous semesters to practical problems/problems faced by industry/development of new facilities
2. Make the students come up with innovative/ new ideas in his area of interest.
3. Identify, analyze and develop opportunities as well as to solve broadly defined mechanical Engineering problems
4. Enhance students' appreciation of the values of social responsibility, legal and ethical principles, through the analysis and discussion of relevant articles and real time projects

Course outcome

On successful completion of the course, the students will be able to:

Course Outcome		CL	Linked PO	Allotted hours
CO1	Get an idea and confidence in designing, analysing and executing the project.	Analysis/creation	1,2,3,4,8,9,10	**3hrs/Week**
CO2	Apply the knowledge of latest trends in fabrication/ manufacturing and Relate their ideas while executing the project	Analysis/creation	1,2,3,4,8,9,10	
CO3	Have complete understanding of Executing the project	Analysis/creation	1,2,3,4,8,9,10	
CO4	Prepare documents in team and enhance his written and oral communication presentations.	Analysis/creation	1,2,3,4,8,9,10	
CO5	Develop individual confidence to handle various engineering assignments and expose themselves to acquire life skills to meet societal challenges	Analysis/creation	1,2,3,4,5,8,9,10	
		TOTAL		**39 Hours**

MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

Course	Programme Outcome									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
	Basic knowledge	Discipline knowledge	Experiments a practice	Engineering Tools	Engineer and society	Environment & Sustainability	Ethics	Individual and Team work	Communication	Life long learning
PROJECT WORK	1	3	3	2	1	0	0	3	2	3

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.
Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

1. PROJECT WORK: 39 HRS

A. INTRODUCTION

The objective of the project work is to enable the students in convenient groups of minimum of 5 members on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.

B. ROAD MAP FOR THE PROJECT

1. Carry out a session or a seminar from the ISTE Student Chapter coordinator / Programme coordinator with the help of Innovation club / I I I cell for directing the students to identify project areas in the field of their interested including interdisciplinary areas.
2. Power point presentation in seminar should include detail description of project areas related to program, Project report formats, developing personnel writing skills.
3. The Students/Departments may at liberty to form the batch not less than 5 and maximum 8 and get registered with project coordinator/HOD at the end of V semester.
4. Students should take the approval from the Project committee/ Head of department for doing project.
5. After approval the batch of students will be published in department notice board along with guide in the end of 5th semester.
6. All students should finalize their Project immediately before commencement of SEE of 5th semester.
7. The types of project may include:
    - Industrial case study

- Preparation of a feasibility report
- Design and development of equipment.
- The overhauling of existing equipment
- Creation of New facilities

8. The project should be challenging but manageable within the resources and time available.
9. Students should undergo reviews for one times in ^{5th} and one times in ^{6th} semester during the internal assessment. Time table for IA should include project review. The guide should monitor the progress of Project work periodically and it should be finally evaluated for 25 marks at the end of ^{5th} semester and for 25 marks at the end of ^{6th} semester.
10. The IA marks will be evaluated based on oral presentation and assessment by the internal guide by adopting Rubrics being developed by Project committee.
11. Real time problems, Industry related problems, should be chosen and it is a Responsibilities of the project committee / Programme coordinator/ Innovation club / I.I.T. cell to choose the appropriate project and to accept the Project Proposal
12. **Identification of Topic:** The selection of topic is of crucial importance. It should be field of interest. It is advisable to choose the project can be completed on time and within the budget and resources. The topic should be clear, directional, focussed and feasible.
13. An outline of project proposal submitted & synopsis from student will initiate a dialogue between Student and Project coordinator who will then help you to work on the chosen topic and report.

C. Industrial visit

Students are required to undergo an industrial visit for period of at least 3(Three) working days, in V semester only. After completion of their visit the reports should be prepared. Each Student should write the report independently in view of his own observation in industry. All days for the visit should be accounted for clearly giving attendance particulars. The concern accompanying staff is to check student presence and access progress periodically

D.Industrial report

Students are required to submit a comprehensive report on factory visit with details of the organization where the training was undergone. The comprehensive report should focus on study of plant/ product /process/ along with intensive in-depth study on anyone of the topics such as processes, methods, tooling, plant layout and equipment, highlighting aspects of quality, productivity of the system. Any data, drawings etc should be incorporated with the consent of the Organization. The comprehensive report should be submitted for the end exam for evaluation

E. Thrust areas identified for Project work

Each student may be assigned any one of the following types of project/thesis work:

According to the local needs, the following major projects are suggested:

1. Non-conventional energy

- Low Cost Solar Water Heating System for Domestic Purpose
- Fabrication of Solar cooker
- Study of Community Biogas Plant
- Fabricate a thermally efficient wood burning stove
- Solar lamps
- Solar powered refrigerator

2. Mechatronics/Material handling area

- Motorized object lifting jack
- Key controlled- fork lifter
- Object counting machine
- Stepper motor control with selected steps for conveyor belts
- Robotic arm with gripper
- Material handling device in X,Y,Z motion control
- Robotic crane
- Robotic trolley for material handling

3. Fluid power and control area
   Pneumatic/Hydraulic jack
   Pneumatic/hydraulic crane
   Air compressed spray gun
   Pneumatic transport system
4. Automobile related area
   Regenerative braking system
   Steering controlled headlight
   Engine/motor vibration checker
   Seat belt automatic locking system
   Hydraulic braking
   Electromagnetic shock absorber
   Digital auto speed limiter
5. Motorized wheel chair
6. Design and Fabrication of various types of lab equipment's useful to polytechnic
7. Repair and overhauling of various machine tools and lab equipment's available at polytechnic
8. Critical Study of existing quality systems and inventory control at industry
9. Mechanical industry fabrication related projects
10. Automatic mopping machine to clean the floor area
11. Automatic milling machine with digital control
12. PCB fabrication
13. Any study project related to Mechanical and allied areas in industry
14. Any project related to industry based problems
15 .Any projects related to low cost automation

F. Course Assessment and Evaluation Scheme for Project work

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment met	CIE	IA	Students	At the end of 5 semester)	25	**1.** Project Synopsis. **2.** Plan & Schedule **3.** Industrial visit report	CO1, CO2, CO3,CO4,CO5
				At the end of 6 semester)	25	**1.** Project Report. **2.** Presentation hand outs	CO1, CO2, CO3,CO4,CO5
	SEE	End Exam		End of the course	Project report project model/Study report		
Indirect Assessment	Student Feedback on course		Students	Middle of the course	Feedback forms		CO1Delivery of course
	End of Course Survey			End of the course	Questionnaires		CO1 to CO5 Effectiveness of Delivery of instructions & Assessment Methods

***CIE** – Continuous Internal Evaluation ***SEE** – Semester End Examination

G. Project report

The Project Report should consist of following items.

1. Introduction
2. Review of Literature
3. Study Area
4. Methodology/Design/fabrication/Tests
5. Result and Discussion
6. Conclusion and scope for future study
7. References.

1. Project reports should be typed neatly in Times New Roman letters with font size 14 for titles and 12 for text on both sides of the paper with 1.5 line spacing on a A4 size paper (210 x 297 mm). The margins should be: Left - 1.5", Right - 1", Top and Bottom - 0.75".

2. The total number of reports (**Soft bound**) to be prepared are

- One copy to the department /library

- One copy to the concerned guide(s)
- One copy to the candidate.

3. Before taking the final printout, the approval of the concerned guide(s) is mandatory and suggested corrections, if any, must be incorporated.

4. Every copy of the report must contain

- Inner title page (White)
- Outer title page with a plastic cover
- Candidate declaration and Certificate in the format enclosed both from the institution and the organization where the project is carried out.
- An abstract (synopsis) not exceeding 100 words, indicating salient features of the work.

5. The organization of the report should be as follows

1. Inner title page 2. Abstract or Synopsis 3. Acknowledgments 4. Table of Contents 5. List of table & figures (optional)	Usually numbered in roman

Chapters(to be numbered in Arabic) containing Introduction-, which usually specifies the scope of work and its importance and relation to previous work and the present developments, Main body of the report divided appropriately into chapters, sections and subsections.

The chapters, sections and subsections may be numbered in the decimal form for e.g. Chapter 2, sections as 2.1, 2.2 etc., and subsections as 2.2.3, 2.5.1 etc.

The **chapter must be left or right justified** (**font size** 16). Followed by the **title of chapter centered** (**font size 18**), **section/subsection numbers along with their headings must be left justified** with **section number and its heading in font size** 16 and **subsection and its heading in font size** 14. The **body or the text** of the report should have font size 12.

The figures and tables must be numbered chapter wise

The last chapter should contain the summary of the work carried, contributions if any, their utility along with the scope for further work.

Reference or Bibliography: The references should be **numbered serially** in the order of their occurrence in the text and their numbers should be indicated within square brackets for e.g. [3]. The section on references should list them in serial order in the following format.

1. For textbooks – Dr.Paramar S, Welding process and technology, Khanna publishers, New Delhi, 2 Edition, 2003.
2. For papers – Y.Javadi and I.sattari, Welding distortion in pipes, Journal of pressure vessels and piping, Vol 85, Aug 2008, pp 337-343

Only SI units are to be used in the report. Important equations must be numbered in decimal form for e.g.

- **V = IZ** ..... **(3.2)**

All equation numbers should be right justified.

Separator sheets, used if any, between chapters, should be of thin paper

H.CIE ASSESSMENT FOR FIRST REVIEW(V Semester)

1. Project identification 05 mark
2. Project synopsis 10 mark
3. Industrial visit & Report 10mark

25 Marks

MODEL OF RUBRICS FOR ASSESSING REVIEWS OF PROJECT FOR CIE

Student name	Reg no	Dimension	Scale					Students Score				
			Unsatisfactory	Developing	satisfactory	Good	Exemplary	1	2	3	4	5
		Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic					
		Fulfil team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles					
		Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.					
		Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount					
							Grand Average/Total					

APPENDIX 1 (Cover page)

(A typical Specimen of Cover Page)<Font Style Times New Roman – Bold>

TITLE OF PROJECT REPORT

<Font Size 18><1.5 line spacing>

A PROJECT REPORT

<Font Size 14>

Submitted by

<Font Size 14><Italic>

NAME OF THE CANDIDATE(S)

<Font Size 16>

in partial fulfilment for the award of the diploma

of

<Font Size 14><1.5 line spacing><Italic>

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME

<Font Size 16>

IN

DEPARTMENT OF MECHANICAL ENGINEERING

<Font Size 14>

LOGO

NAME OF THE COLLEGE

<Font Size 14>

DEPARTMENT OF TECHNICAL EDUCATION

BENGALURU-560001

<Font Size 16><1.5 line spacing>

Year of submission: (MONTH & YEAR)

<Font Size 14>

APPENDIX 2 (Title page)

(A typical Specimen of Title Page) <Font Style Times New Roman – Bold>

A Project Report
on

<TITLE OF THE PROJECT WORK>

Submitted for partial fulfilment of the requirements for the award of the
of

DIPLOMA IN CIVIL ENGINEERING

BY
BATCH
<Mr. / Ms. Name of the Student (Roll No.)>
<Mr. / Ms. Name of the Student (Roll No.)>
<Mr. / Ms. Name of the Student (Roll No.)>
<Mr. / Ms. Name of the Student (Roll No.)>
<Mr. / Ms. Name of the Student (Roll No.)>

Under the guidance of

<Name of the Staff>
Lecturer
Department of ME
GPT, Place--------

Department of Mechanical Engineering
<<NAME OF INSTITUTE>>
<<ADDRESS OF INSTITUTE>>

APPENDIX 3 (Certificate)

(A typical specimen of Bonafide Certificate)
<Font Style Times New Roman>

DEPARTMENT OF TECHNICAL EDUCATION BENGALURU-560001

<Font Style Times New Roman – size -18>

BONAFIDE CERTIFICATE

<Font Style Times New Roman – size -16>

<Font Style Times New Roman – size -14>

Certified that this project report **"…….TITLE OF THE PROJECT……..."**is the bonafide work of "**……..NAME OF THE CANDIDATE(S)……"**who carried out the project work under my supervision.

<<Signature of the Head of the Department>>

SIGNATURE

<<Name>>

HEAD OF THE DEPARTMENT

<<Department>>

<<Full address of the Dept & College >>

<<Signature of the Project cordinator>>

SIGNATURE

<<Name>>

PROJECT CORDINATOR

<<Academic Designation>>

Department of Mechanical Engineering

<<Full address of the Dept & College >>

Examiners 1.....<<Signature, Name, Designation& Address>>.....

Examiners 2.....<<Signature, Name, Designation& Address>>.....

APPENDIX 4 (Candidate declaration)

CANDIDATE'S DECLARATION

I, ---------- a student of Diploma in ---------- Department bearing Reg No----------of ---------- hereby declare that I own full responsibility for the information, results and conclusions provided in this project work titled **"**----------"submitted to **State Board of Technical Examinations, Government of Karnataka** for the award of Diploma in ----------.

To the best of my knowledge, this project work has not been submitted in part or full elsewhere in any other institution/organization for the award of any certificate/diploma/degree. I have completely taken care in acknowledging the contribution of others in this academic work. I further declare that in case of any violation of intellectual property rights and particulars declared, found at any stage, I, as the candidate will be solely responsible for the same.

Date:

Place: **Signature of candidate**

Name: ----------

Reg No----------

--

APPENDIX 5 (Certificate issued by guide)

DEPARTMENT OF TECHNICAL EDUCATION

NAME OF THE INSTITUTION

Address with pin code

Department of …….

CERTIFICATE

Certified that this project report entitled ----------

---- ----------”which is being submitted by Mr./Ms. ……..……., Reg. No…..……, a bonafide student of ……in partial fulfilment for the award of **Diploma in ----------Engineering** during the year …….... is record of students own work carried out under my/our guidance. It is certified that all corrections/suggestions indicated for internal Assessment have been incorporated in the Report and one copy of it being deposited in the polytechnic library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said diploma.

It is further understood that by this certificate the undersigned do not endorse or approve any statement made, opinion expressed or conclusion drawn there in but approve the project only for the purpose for which it is submitted.

Guide(s)

Name and signature

Examiner 1

2 **Head of Department**

Dept. of ----------

APPENDIX 6

Format of Synopsis

1. Title of the Project
2. Objectives of the study
3. Rationale for the study
4. Statement of the Problem
5. Detailed Methodology to be used for carrying out the study
6. The expected contribution from the study (to perform any laboratory experiments)
7. List of activities to be carried out to complete the project (with the help of a bar chart showing the time schedule)
8. Places/labs/equipment and tools required and planning of arrangements
9. Problems envisaged in carrying out the project, if any.
10. Brief description of project in 100 words

APPENDIX-7 (PROJECT-TIME LINE)

	TASK	Responsibility	END OF V SEMESTER					VI SEMESTER												
	WEAKS		11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Industrial visit	Students/Faculty																			
1	Seminar regarding Project work	Project Com/HOD																			
2	Batch formation &Guide allocation	HOD																			
3	Identification of project	Students/Guide																			
4	Project synopsis Submission	Students																			
5	Finalisation of Project	Students/Guide																			
6	Literature survey	Students/Guide																			
7	Identification of facility to do PW	Guide																			
8	Study/Fabrication/design of model	Students/Guide																			
9	Results discussion/performance testing	Students																			
10	Review of Project work by guide	Students																			
11	Project report submission	Students/Guide																			

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

Course Title: **ESTIMATION AND COSTING**		
Scheme (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15ME61T**
Type of Course: **Lectures, Self Study & Quiz**	Credit **:04**	Core/ Elective: **Core**
CEE:25 Marks		SEE:100 Marks

Prerequisites: Knowledge of Mathematics, Work shop technology, Machine Tool Technology

Course Objectives:

This course will also help in developing the skills required in Estimate production/operation cost for budgeting and analysis.

Course Outcomes:

On successful completion of the course, the students will be able to attain CO:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Understand the concept of estimation and costing. Analyze the concept of depreciation cost.	***R/U/A/Ev***	1,2	**08**
CO2	Know the components of costing and Determine material cost of simple machine components.	***R/U/A/Ev***	1,2	**10**
CO3	Ability to estimate the various machining operations.	***R/U/A***	1,2	**10**
CO4	Ability to estimate the various Welding & Sheet metal components.	***U/A***	1,2	**09**
CO5	Ability to estimate the various Forging & Foundry Shop components.	***U/A***	1,2	**09**
CO6	Understand the concept of Process costing, and types of Budget, and familiarize with accounting terminology.	***U***	1,2	**06**
		Total sessions		**52**

Legend: R: Remember U: Understand A: Application An: Analysis

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
ESTIMATION AND COSTING	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

Unit No	Unit Name	Hour	Questions to be set for SEE/Marks			Marks weightage	weightage (%)
			R	U	A		
1	Introduction to Estimation & costing	08	5	5	10	20	13.79
2	Estimation of materials cost	10	5	5	20	30	20.68
3	Estimation of Cost in machine shop	10	5	10	20	35	24.16
4	Estimation of Cost in Welding & Sheet metal shop	09	-	5	20	25	17.24
5	Estimation of Cost in Forging shop & Foundry Shop	09	-	5	20	25	17.24
6	Process costing & Accounting	06	-	10	-	10	6.89
Total		52	15	40	90	145	100

Legend: R; Remember, U: Understand A: Application

UNIT I: INTRODUCTION TO ESTIMATION & COSTING 08 Hrs

Estimation - Definition, Importance and Aims- Qualities and functions of an Estimator- Source of errors in estimation- Constituents of Estimation- Costing - Definition and Aims - Difference between costing and estimating- - Depreciation and obsolescence: Definition, types, different methods of calculating depreciation- numeric examples.

UNIT II: ESTIMATION OF MATERIALS COST 10 Hrs

Material - Direct material, indirect material and examples- Calculation of Material cost - Labour - direct, indirect labour and examples - Calculation of labour cost - Expenses - direct, indirect expenses and examples- Classification of expenses - factory, administrative, selling and distribution expenses - Fixed and variable expenses - Components of cost - prime cost, factory cost, office cost, total cost - Block diagram to show the relationship between elements and components of cost -Determination of selling price - Break even analysis - break event

chart, diagram to illustrate break event point-Estimation of materials cost of step pulley, spindle lathe centre, Rivets, Fly wheel, Crankshaft, Chain link, Wedge and Gib-headed key.

UNIT III: ESTIMATION IN MACHINE SHOP 10 Hrs

The terminology associated with machine shop estimation- Definition of cutting speed, feed, depth of cut- Procedure of estimating cost of machined part for following operations: Lathe operations (Facing, outside/inside turning, boring, drilling on lathe, grooving and threading). Drilling operations (Drilling, reaming, tapping)-Shaping operations- Milling operations (Face milling, side and face cutting, end milling)- Cylindrical grinding operations (Plain cylindrical grinding)- For given machined part, estimate material cost and machining cost.

UNIT IV: ESTIMATION IN WELDING & SHEET METAL SHOP 09 Hrs

Estimation in welding shop - gas welding cost, arc welding cost - production cost of given welding job- the types of welding costs- the factors affecting the welding cost.
Estimation in sheet metal shop - Sheet material and gauge number, Sheet metal joints - Estimate the material required for preparation of container open on one side, Cylindrical drum, funnel and tray.

UNIT V: ESTIMATION IN FORGING SHOP & FOUNDARY SHOP 09 Hrs

Cost terminology associated with forging shop- The procedure for calculating material cost of a product for forging shop- Procedure for estimating forging cost- forging losses to be considered while estimating -Estimation of forging cost.
Estimation in foundry shop-pattern allowances- The procedure for calculating material cost of a product for foundry shop - Procedure for estimating cost of pattern making. -Procedure for estimating foundry cost of components such as C.I pulley and C.I. Wheel and estimate foundry cost.

UNIT VI: PROCESS COSTING & ACCOUNTING 06 Hrs

Process & Job Costing -Characteristics -Principles -Procedure for Process costing.
Wages-types, Incentives-types, Budget-Types, Accounting terminology like -book value-Net Present Value-Work in progress- Gross Domestic Product (GDP)-balance sheet-Tendering-manual tendering and e-tendering.

TEXT BOOKS

Sl.No.	Title of Books	Author	Publication
1.	Mechanical estimation and costing	T.R.Banga and S.C.Sharma	Khanna publishers
2.	Mechanical Estimation	Malhothra	-
3	Industrial Organisation and Engineering Economics	T.R.Banga and S.C.Sharma	Khanna publishers
4.	Mechanical Estimation	NITTTR Chennai	NITTTR Chennai
5	Mechanical costing and estimation.	Singh and Khan	Khanna Publishers
6	Process planning & cost estimation	M.Adithan	New age International

LIST OF SOFTWARES/ LEARNING WEBSITES:

i. http://calculatoredge.com/index.htm#mechanical

SPECIAL INSTRUCTIONAL STRATEGIES

UNIT NO	UNIT NAME	STARATEGIES
1	Introduction to Estimation & costing	Lectures, Discussions Presentations
2	Estimation of materials cost	Demonstration of method to estimate cost taking live demonstration at work shop place, steps based handouts
3	Estimation of Cost in machine shop	Demonstration of method to estimate cost taking live demonstration at work shop place, steps based handouts
4	Estimation of Cost in Welding & Sheet metal shop	Demonstration of method to estimate cost taking live demonstration at work shop place, steps based handouts
5	Estimation of Cost in Forging shop & Foundry Shop	Demonstration of method to estimate cost taking live demonstration at work shop place, steps based handouts
6	Process costing& budget	Discussions, real life industries situation, industrial visits

SUGGESTED LIST OF STUDENT ACTIVITYS

Note: the following activities or similar activities for assessing CIE (IA) for 5 marks (Any one)

- Each student should do any one of the following type activity or similar activity related to the course and before take up, get it approved from concerned Teacher and HOD.
- Each student should conduct different activity and no repeating should occur

1	Collect the finished parts from industries/market/scrap merchants Measure the dimensions and prepare production drawings of the parts using A4 size paper. Estimate the material cost
2	**Welding estimation:** a. Determine raw material volume for all welded parts. b. Select welding rod to be used. Estimate quantity of welding rod required. c. Determine material and consumables costs. d. For each part, estimate welding cost. Show the assumptions and steps followed to estimate welding cost. e. Derive total cost of the part.
3	**Casting estimation:** a. Determine raw material volume for all casted parts (Determine input weight, cut weight, net weight, losses etc.). b. Prepare pattern drawings (production drawings with all dimensions, surface finishes, allowances, etc.) for all parts. c. Estimate pattern cost. d. Determine material and consumables costs. e. For each part, estimate casting cost. Show the assumptions and steps followed to estimate casting cost. f. Derive total cost of the part.
4	**Forging estimation:**

	a. Determine raw material volume for all forged parts. b. Prepare die drawings (production drawings with all dimensions, surface finishes, allowances, etc.) for all parts. c. Estimate dies cost. d. Determine material and consumables costs. e. For each part, estimate forging cost. Show the assumptions and steps followed to estimate forging cost. f. Derive total cost of parts.
5	**Machining estimation:** a. Determine raw material volume for all machined parts. b. For each part, tabulate operation, cutting tool/s to be used and cutting parameters (speed, feed and depth of cut) to be used. c. Estimate raw material cost. d. For each part, estimate machining cost. Show the assumptions and steps followed to estimate machining cost. e. Derive total cost of parts

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	Three IA tests(Average of three tests will be computed)	20	Blue books	1,2,3,4,5,6
				Student activities	05	Activity sheets	1,2,3,4,5,6
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

CIE- Continuous Internal Evaluation SEE- Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks evaluated through appropriate rubrics.
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS MODEL

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity.

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th weak of sem 10-11 Am	VI SEM	**ESTIMATION & COSTINNG**	20
	Year: 2016-17	Course code:15ME61T	

Name of Course coordinator : Units:1,2 Co: 1,2

Note: Answer all questions

Question no	Question	MARKS	CL	CO	PO
1	Define estimation. List the aims of estimating	05	U	01	2
2	Name the various components of cost. Give brief descriptions of the component.	05	R	02	2
3	A machine was purchased for Rs 30000/-. The cost of erection charges was Rs 10000/- , the estimated life of the machine was 20 years. The scrap value at the end of useful life was Rs 8000/-. Determine the rate of depreciation per year by straight line method. After 10 years the machine underwent major repairs and the repair cost was Rs 6000/- .What will be the new rate of depreciation per year.	10	A	01	1,2

MODEL QUESTION PAPER

VI- Semester Diploma Examination

Course Title: **ESTIMATION & COSTINNG**

Time: **3 Hours**] [Max Marks**: 100**

Note: Answer any **SIX from Part A** and any **SEVEN from Part B**

PART-A

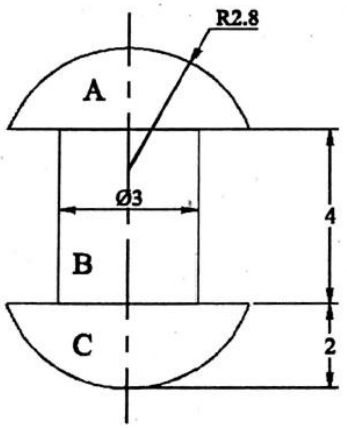
6x5=30 marks

1. Define estimation. Mention the aims of estimating
2. Explain the Straight line method of calculating depreciation
3. Name the various components of cost. Give brief descriptions of the component.
4. Distinguish between fixed and variable overhead
5. Define cutting speed, feed, depth of cut for lathe operations
6. Explain the Procedure of estimating cost of machined part for Lathe operations
7. Explain the various operation time to be considered for estimation of machining time.
8. Explain the types of sheet metal joints.
9. Explain the pattern allowances.

PART-B

7x10=70 marks

1. An industrial plant with initial value of Rs. 400000/- has a salvage value of Rs.50000/- at the end of 25 years, but sold for 260000/- at end of 10years. What is the profit or loss to the owner, if sinking fund method of depreciation is adopted? Take interest rate @ 8%.
2. A catalogue price of a machine is Rs 6000/- and the discount allowed to the distributors is 20% of the catalogue price. At some stage, it was found that the selling expenses were half the factory cost and material cost, labour cost and the factory overheads were in the ratio of 1:4:2 if the material cost was Rs 400/-. What profit was made by the factory on each machine
3. Determine the number of rivets of dimensions as shown in the figure. Which can be manufactured from 4 Kg of MS. Assume that there is no wastage of material density of MS is 8 gm/cc. All dimensions are in cm.



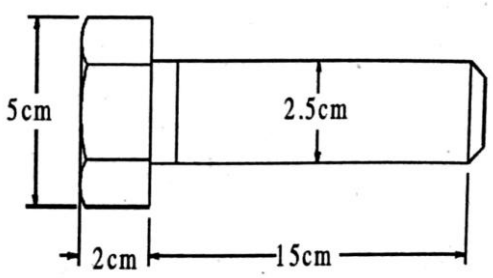
4. A tapered component is to be manufactured in a lathe by compound rest method out of a given bar of 60mm dia and 100 mm length. Assume the following data:

Details of tapered components

Major dia =60mm
Minor dia =20mm
Length of taper =100 mm

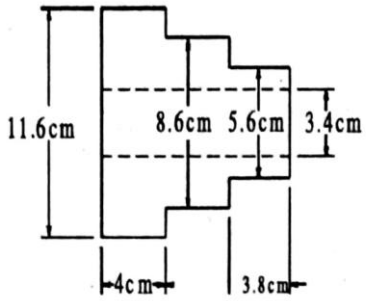
Cutting speed 75 m/min. hand feed by compound rest =0.05 mm/rev depth of cut should not exceed 4 mm. Determine the time required for machining. All dimensions are in mm.

5. A 20 X 7.5 cm CI surface is to be faced on milling machine with a cutter having a diameter of 125 cm and 20 teeth. If the cutting speed and feed are 50m/min and 4.5 cm/min respectively, determine the milling time, rpm of the cutter and feed per tooth.
6. Estimate the time required for making an open tank of size 50x50x50 cm by gas welding. Size of sheet used is 50x50x0.3 cm welding is to be done on both sides. Assume fatigue allowance to be 10% and welding speed outside as 6m/hr and inside 5m/hr.
7. Two 1m long MS plates of 10mm thickness are to be welded by a lap joint with the help of a 6 mm electrode. Determine the cost of welding
   a. Current used :250 amp
   b. Voltage : 30 V
   c. Welding speed : 10m/hr
   d. Electrode used : 0.4 kg/m of welding
   e. Labour charges Rs 1/ hr
   f. Power charges Rs 0.20/KWh Cost of electrode Rs 5/kg
8. Estimate the size of stock and weight of material required to forge 100 MS bolts as shown in figure. The bar stock diameter is 3 cm.



9. Estimate the cost of 2000 CI pulleys as shown in figure. Its surfaces are to be machines after casting. The pattern is supplied by the customer itself. Following data can be used:

Cost of metal = Rs.5/kg
Moulds prepared by each worker/day=20
Melting charges = 20% of metal cost
Machining allowance on each side may be taken as 2mm
Wages of each moulder =Rs. 16/day
Density of CI = 7.2 gm/cc
Overhead charges = 25% of metal cost.



10. a)Explain the procedure for process costing
    b) Compare manual tendering with e-tendering

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MODEL QUESTION BANK

Diploma in Mechanical Engineering
VI Semester
Course title: ESTIMATION & COSTING

CO1: Understand the concept of estimation and costing and Analyse the concept of depreciation cost.

REMEMBERING

Chapter-I: Introduction to Estimation and costing

1. Define estimation.
2. List the functions of an estimator.
3. Define costing.
4. List the various costing methods
5. What are the advantages of efficient costing?
6. Define standard cost. Write the advantages of standard cost.
7. Define the following terms
    a. Depreciation
    b. Estimation.
8. Define obsolescence. List the various methods of calculating depreciation
9. List the causes of depreciation
10. Name six methods of calculating depreciation.
11. List the aims of estimating
12. List the essential qualities of an estimator.

UNDERSTANDING

10. Explain the various qualities of estimator
11. Explain the procedure for carrying out estimation.
12. What are the sources of errors in estimating
13. Explain the idleness in industries and list the various form of idleness.
14. Explain the need of an estimation for industrial project
15. Compare estimation with costing
16. Explain the steps involved in estimating procedure.
17. Explain the Straight line method of calculating depreciation
18. Explain the Sinking fund method of calculating depreciation
19. Explain the diminishing balance method for calculating the depreciation
20. Explain the terms
    a. Repair and maintenance
    b. Obsolescence
21. Explain the aims of estimation
22. Explain on the various functions of an estimator
23. Compare man hour rate with machine hour rate
24. Comparison depreciation with obsolescence
25. Explain fixed instalment method of depreciation

APPLICATION / EVALUATING

9. A machine was purchased for Rs 30000/-. The cost of erection charges was Rs 10000/- , the estimated life of the machine was 20 years. The scrap value at the end of useful life was Rs 8000/-. Determine the rate of depreciation per year by straight line method. After 10 years the machine underwent major repairs and the repair cost was Rs 6000/- .What will be the new rate of depreciation per year?
.
10. The installation cost was Rs 11950/-. The apparatus has a life expectancy of 20 years with a scrap value of Rs 6000/-. What should be the rate of depreciation and depreciation fund on 1.1.1990 by reducing balance method?
11. A lathe is purchased for Rs 80000/-. The assumed life is 10 years and scrap value Rs 8000/-. If the depreciation is charged by diminishing balance method. Determine the rate by which the value of lathe is reducing every year and Estimate the depreciation fund after 2 years.
12. A machine is purchased for Rs 60000/-. The estimated life of machine is 15 years and the scrap value is Rs 15000/-. Determine the depreciations per year by using interest law (Sinking fund) method, if the rate of interest is charged at 5%. Estimate the depreciation at the end of 5 years.
13. An industrial plant with initial value of Rs. 400000/- has a salvage value of Rs.50000/- at the end of 25 years, but sold for 260000/- at end of 10years. What is the profit or loss to the owner, if sinking fund method of depreciation is adopted? Take interest rate @ 8%.
14. A machine was purchased for Rs.40000/- the useful life of machine is 15 years. The scrap value of the machine is Rs.1000/- . after 5 years, the machine was sold for Rs.24000/-. If depreciation was set aside by sinking fund method, the rate of interest @ 8%, determine the extra capital needed to purchase the new machine for Rs.50000/-.
15. The cost of the machine is Rs. 16000 and its scrap value is Rs.4000/-. Determine the depreciation by “sum of the years digits method “charges for the year, if the estimated life of the machine in 4 years.
16. Determine the depreciation at the end of each year by the sum of years digits method (SYD), if the life of the plant is 5 years. The assets of the company are Rs.360000/- and scrap value is Rs.60000.

CO2: know the components of costing and Determine material cost of simple machine components..

REMEMBERING

1. List out the various elements of cost
2. Name the various components of cost.
3. List the various indirect expenses.

UNDERSTANDING

4. Compare direct expenses with indirect expenses.
5. Comparison fixed with variable overheads.
6. Explain the overhead charges.
7. Explain the following a) personal allowance b) fatigue allowance
8. Explain the control on prime cost, control on overheads and control over indirect materials and tools.
9. Explain the unit rate method designed for allocation of on cost
10. Explain each element of cost with suitable examples
11. Explain each components of cost with suitable examples

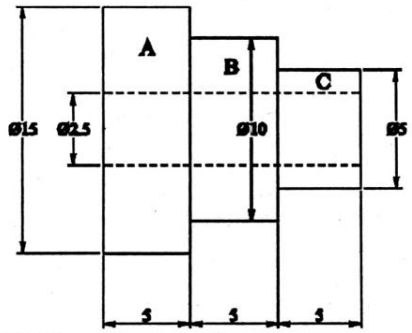
12. Illustrate various elements of cost in determining the price of a product with the help of a block diagram.
13. Explain a) Prime cost b) Direct material Cost c) Direct labour cost
14. Explain the method involved in calculation of direct material cost.

APPLICATION/EVALUATION

1. The direct material used is Rs 1000/- and the direct wages are Rs 443/- for the manufacture of certain items. Determine the factory cost, when the oncost is to be 60% of prime cost.
2. A certain articles are manufactured in bathes of 100. The direct material cost is Rs. 250/- , direct labour cost Is Rs.400/- and factory overheads is Rs. 290/-. If the selling on cost is 40% of prime cost. What should be the selling price of each product to obtain a profit of 20% on the selling price?
3. A machine is manufactured by a firm in batches of 100. The direct material cost is Rs 1600/- and direct labour cost is Rs 2000/-. Factory on cost is 30% of the prime cost. Overhead charges are 20% of factory cost. If the management wants to make a profit of 10% on the selling price. Determine the selling price of each machine.
4. A concern produces bolts & nuts of aluminium and estimated cost is given on the basis of a lot of 1000 bolts with nuts, length of bolt with head 10cm and diameter 2cm.
   i) Material cost Rs 700
   ii) Labour cost (direct)
      a) Cutting and setting up =Rs 150
      b) Milling, threading, drilling = Rs 160/-
   iii) Cost of tools =Rs 100/-
   iv) Factory overheads =150% of total labour cost
   v) Office on cost = 30% of factory cost
   vi) Selling price = Rs 2/ piece
   Determine whether management is making profit or loss per piece.
5. Estimate the total cost of two products A & B of on cost is 60% of prime cost. The product has Rs 200/- as direct material and Rs 400/- as direct labour cost, While the product B has Rs 300/- as direct labour cost and Rs 300/- as direct material cost.
6. A lot of 5000 pieces of an item was fabricated and the following cost were incurred
   - Material cost Rs 1000/-
   - Labour cost Rs 1100/-
   - Cost of tool/etc Rs 125/-
   - Factory oncost 150% labour cost
   - Office oncost 25% of factory cost
   - Selling expenses 20% of oncost production

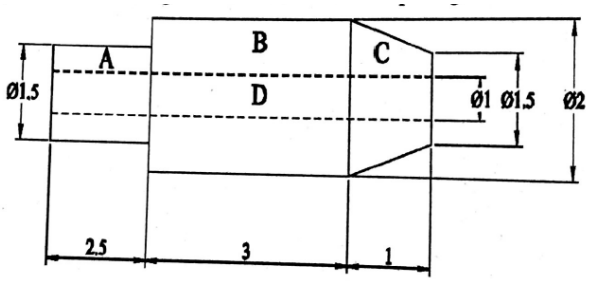
   What should be the profit or loss if the price of each item is fixed at Rs 1.50
7. A catalogue price of a machine is Rs 6000/- and the discount allowed to the distributors is 20% of the catalogue price. At some stage, it was found that the selling expenses were half the factory cost and material cost, labour cost and the factory overheads were in the ratio of 1:4:2 if the material cost was Rs 400/-. What profit was made by the factory on each machine.
8. A market price of a machine is Rs 50000/- and the discount allowed to the distributor is 20% of the material price. Selling expense cost is ¼ of the factory cost. If the material cost, Labour cost and factory overhead charges are in the ratio of 2:4:1, What profit is going to be made by the factory on each machine, if the material cost is Rs 8000/-.

9. An article can be made either by hand or in large quantities by mass production. In the farmer case, time taken is 3hrs and overheads is 25% of labour cost. While in the later case time taken for 10 pieces is 8Hrs, but overheads are 150% of the labour cost, material cost is Rs 15/ piece and labour charges are Rs 8/Hr. Compare the total cost in both the cases. Which is cheaper?
10. A factory owner employed 50 workers during the month of march 2000. Whose details of expenditure are as given below: a) Material cost is Rs 100000/- b) Rate of wages for each worker is Rs 6/Hr c) Duration of work is 8hrs/day d) No. of holidays in the month is 6 days and e) Total overhead expenses is Rs 50000/-. If workers were paid overtime of 200Hrs at the rate of Rs10/Hr. Determine i) Total cost ii) Man hour rate overheads
11. Estimate the weight of cast iron used in manufacturing step pulley as show in figure. Assume density of CI as 7.2 gm/cc.

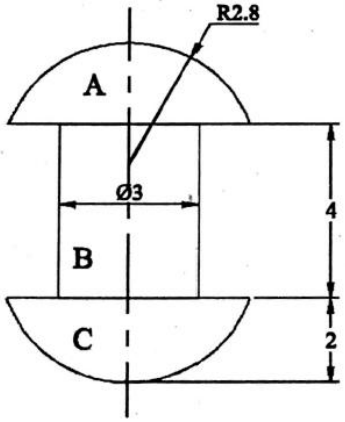


All dimensions are in cm

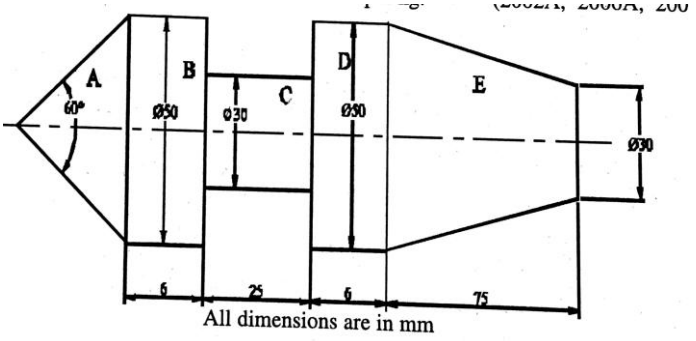
12. Determine the weight and cost of material of MS spindle as shown in figure. The density of MS is 7.8 gm/cc and rate is Rs.15 per Kg.



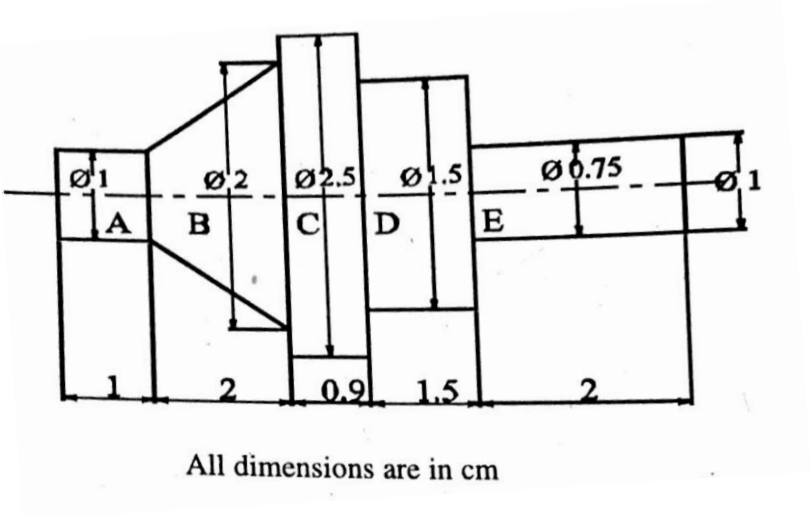
13. Determine the number of rivets of dimensions as shown in the figure. Which can be manufactured from 4 Kg of MS. Assume that there is no wastage of material density of MS is 8 gm/cc. All dimensions are in cm.



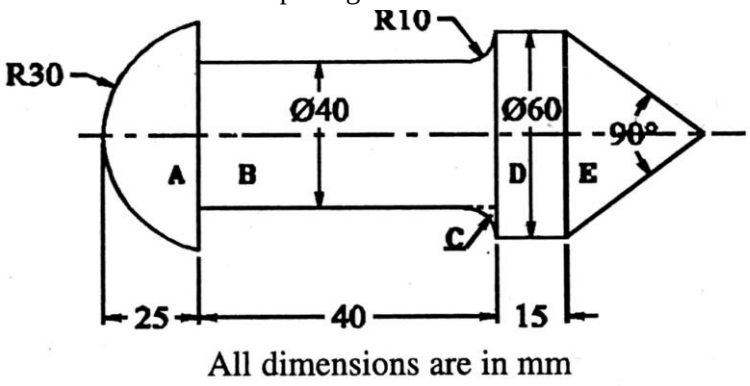
14. Figure shows a lathe centre. Evaluate the weight and cost of the material which weighs 7.85 gm/cm$^{3.}$ The cost of the material is Rs. 20 per kg.



15. Estimate the volume of the material required for manufacturing 100 pieces of shaft shown in figure. The shaft is made-up of MS weights 8 gm/CC and cost is Rs.60 per kg. Determine the material cost for such shafts.

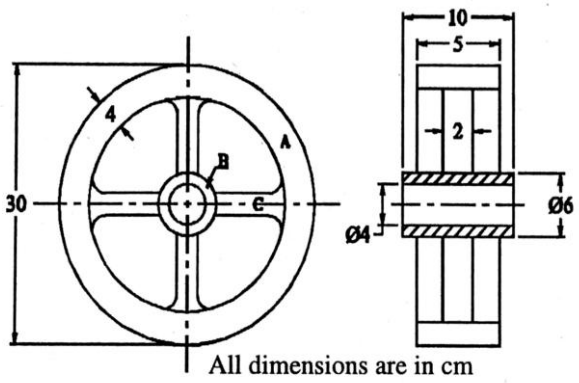


16. Determine the weight and cost 200 articles of MS as shown in figure. Assuming suitable density and the material cost as Rs.12 per Kg.



17. Determine the material cost of ten gun metal bushes of 15 cm length including flanges at both the internal dia. Of the bush is 4 cm, external dia is 8 cm and outer dia of the end flanges is 12 cm. assume density of metal as 8.5 gm/cc and cost of the material is Rs.200/kg.

18. Determine the weight of the gear blank of CI as shown in figure. Taking its density as 7.4 gm/cc.



19. Estimate the material cost of an engine flywheel from the following data:

Inside dia of the flywheel rim	=70 cm
Outside dia of rim	=100 cm
Width of rim	=25 cm
Inside dia of hub	=12 cm
Outside dia of hub	=24 cm
Length of hub	=30 cm
Section of arms (elliptical)	=7 cm X 4 cm
Length of arm	=23 cm
No. of arms	=4
Density of material	=8 gm/cc
Material cost	= Rs.25/kg
Neglect tapering of arms .	

CO3: Ability to estimate the various machining operations

REMEMBERING

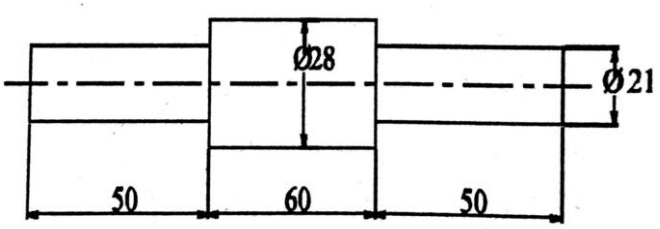
1. List the various operations performed in machine shop.
2. Define cutting speed, feed, depth of cut for lathe operations
3. Define cutting speed, feed, depth of cut in lathe

UNDERSTANDING

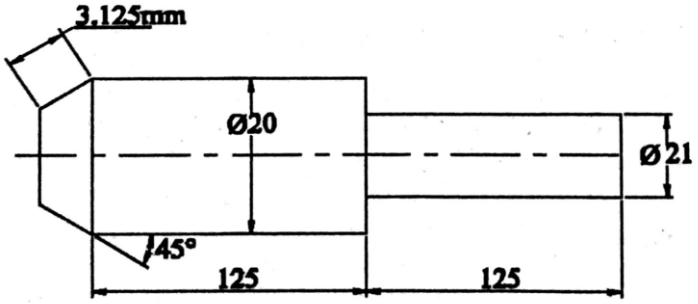
1. Explain the various operation time to be considered for estimation of Machining time.
2. Explain the Procedure of estimating cost of machined part for Lathe operations
3. Explain the Procedure of estimating cost of machined part for Milling operations
4. Explain the Procedure of estimating cost of machined part for Cylindrical Grinding operations.

APPLICATION

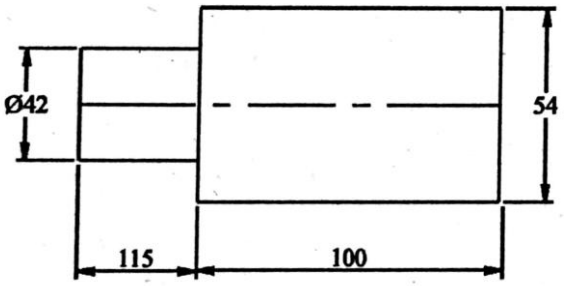
1. Estimate the time required to turn 3.5 cm dia bar to dimension shown in figure. Cutting speed is 15.4 m/min and feed is 1 mm/rev. all cuts are 3.5 mm deep.



2. (a) How much time will be required to reduce a 42mm bar to dimension shown in figure. With cutting speed 16.5 m/min and feed is 1 mm/rev. assume all cuts are 2.5 mm deep. (b) How long will it take to machine a 45^{o} X 3.125 mm chamfer?



3. Estimate the time required to run a 60mm dia rod to the dimension shown in figure. Taking cutting speed as 20m/min, feed as 1.2 mm. all cuts are 3mm deep. All dimensions are in mm.



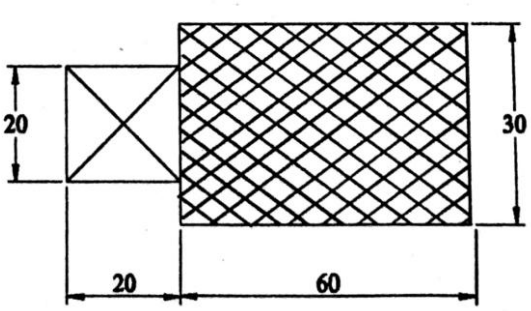
4. A tapered component is to be manufactured in a lathe by compound rest method out of a given bar of 60mm dia and 100 mm length. Assume the following data:

   Details of tapered components

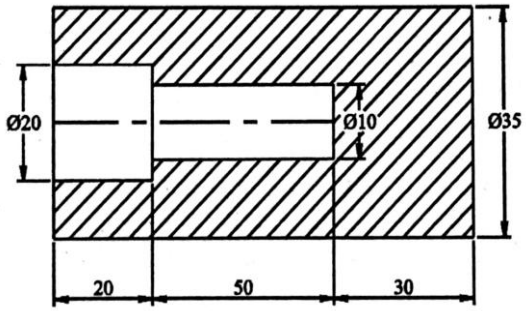
   Major dia =60mm
   Minor dia =20mm
   Length of taper =100 mm

   Cutting speed 75 m/min. hand feed by compound rest =0.05 mm/rev depth of cut should not exceed 4 mm. Determine the time required for machining. All dimensions are in mm.

5. A component shown in figure is to be knurled on the surface. Estimate the time required for knurling it, if the cutting speed is 20m/min and feed is 0.03 cm/rev.

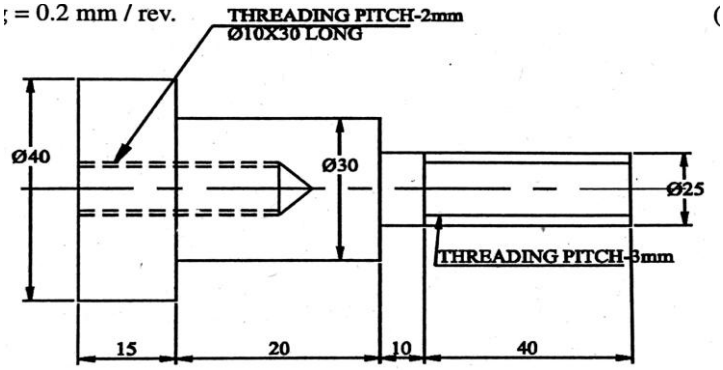


6. Determine the time required for drilling component as shown in the figure. Assume cutting speed as 22 m/min and feed as 0.02 cm/rev. all dimensions are in mm.



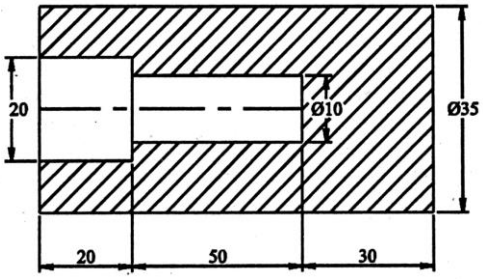
7. Estimate out the time for threading on a 3 m dia aluminium bar of length of 10cm by single point tool, if 3threads/cm are to be cut and speed bar is 80rpm. Assume suitable approach over run and no. of cuts.
8. Determine the time required for cutting two threads/cm on aluminium bar stock of 3.5 cm diameter and for a length of 10cm. assume cutting speed as 11m/min. neglecting approach and overtake for the tool.
9. Estimate the time required for tapping a 2cm dia. Hole with a 3 mm pitch tap in a MS plate upto a depth of 3cm. assume cutting speed as 10m/min and return speed of tap as 2 times the cutting speed.
10. Estimate out the time required for tapping a 2.1 cm dia hole with 2.5 mm pitch tap in a mild steel plate upto a depth of 3.5cm. assume cutting speed as 11m/min and also assume that return speed of tap is twice the cutting speed. No. of cuts required is 6.
11. What is the feed per tooth of a 32 teeth milling cutter of 40 cm dia , having a speed of 75 rpm, table feed 30per min. also Estimate the time required to face mill a CI casting 1.5 m long and 24 cm wide.(take allowances into consideration).
12. Estimate the time required to face a job 20 cm lomg and 10 cm wide with the help of milling cutter of 10cm dia, having 8 teeth and revolving at 80 rpm. The feed per tooth should not exceed 0.125 mm. assume that the width of the cutter is sufficient to mill the whole of the job at a time.
13. A 20 X 7.5 cm CI surface is to be faced on milling machine with a cutter having a diameter of 125 cm and 20 teeth. If the cutting speed and feed are 50m/min and 4.5 cm/min respectively, determine the milling time, rpm of the cutter and feed per tooth.
14. A slot is tobe made on a milling machine with the help of a cutter, revolving at 100 rpm. Finf the time required to prepare the slot in two cuts, if it is 15 cm deep and 20 cm long with a cutter of 10 cm dia. Assume feed as 0.5 mm/rev.
15. A slot of length 25 cm and of depth 3.375 cm is to be milled by 12.5 cm diameter cutter. What is the total table travel to complete the cut? Also Estimate the time required for milling the slot when the cutter is turning at 191 rpm with an average feed of 0.0125 cm and having 16 teeth.

16. Estimate the time required to cut 60 teeth on a gear blank of 50 mm thick, with a feed of 30 mm/min. take added table travel as 10 mm and setup time as 10 minutes.
17. Estimate the time taken to prepare a square prism on a milling machine from a round block 90 mm length and 40 mm dia. Feed 25mm/min. setup and indexing time is 15 minutes.
18. Determine the time taken for shaping a cast iron block 50 cm long and 30cm wide in a single cut. Feed is taken to be 0.8 mm/ stroke and cutting speed 1 m/min.
19. Estimate the time required for planning a piece of mild steel75 cm long and 30 cm wide on a planning machine. The cutting speed on the tool is 10 m/min and feed 0.0782 cm/ stroke.
20. A machine bed is to be planed in two cuts on a planning machine. It takes 10 seconds in forward stroke and 7 seconds in return stroke. Estimate out the time required to plane the bed of width 40cm. assume the feed as 1mm/stroke.
21. Estimate the time required for doing rough grinding of a 16cm long steel shaft to reduce its dia from 4.2 to 4 cm in a grinding wheel of 12 cm face width. Assume cutting speed as 16.5m/min and depth of cut as 0.25mm.
22. The top of a cast iron table of size 40 X 9 cm is to be ground by a wheel having 2 cm face width. If the feed is 1/4th of the width of the wheel and the table moves 9m in one minute. Estimate out the time required for grinding in two cuts.
23. Estimate out the machining time to complete the job as shown in figure. From the basic raw material of 50 mm dia and 100 mm length. Cutting speed for turning 30 m/min, feed=1mm/rev, depth of cut=2.5mm. cutting speed for thread cutting=9 m/min. cutting speed for drilling=30m/min and feed for drilling=0.2 mm/rev.



24. Estimate the time taken to prepare a job according to the dimensions shown in figure. From a bar 3.5 cm dia and 6 cm long. Assume following data.

Cutting speed for turning and boring	= 20m/min
Cutting speed for drilling	=30m/min
Feed for turning and boring	= 0.2mm/rev
Feed for drilling	= 23 mm/rev
Depth of cut not to exceed	= 3mm.



25. It is desired to manufacture 100 bolts/day from MS bar of length 10 cm and diameter 30 mm. bolt has the following dimensions: dia of shank=1.2cm, dia of head =20 mm, thickness of head=10mm, lengt of bolt (face to face) = 10 cm. length of threaded portion = 3cm. assume

i) feed for turning =0.2cm/rev
ii) cutting speed for turning =20m/min
iii) cutting speed for threading = 10m/min
iv) depth of cut = max. of 3mm
v) pitch of threads = 2.5 mm
vi) no. of cuts required for threading =6

Determine the machining time for 100 bolts if the operator is paid at the rate of Rs. 4.25 per hour. Estimate the labour charges considering other allowance for fatigue etc as 100%.

CO4: Ability to estimate the various welding & sheet metal components

UNDERSTANDING

1. Explain the any five sheet metal operations.
2. Explain the types of sheet metal joints.
3. Explain types of welding.
4. Explain the types of welding costs.
5. Explain the factors affecting the welding cost.

APPLICATION

Estimation in welding shop

1. Estimate the time required for making an open tank of size 50x50x50 cm by gas welding. Size of sheet used is 50x50x0.3 cm welding is to be done on both sides. Assume fatigue allowance to be 10% and welding speed outside as 6m/hr and inside 5m/hr.
2. Estimate the material cost for linear welding of two flat pieces of MS 45cm x 6 cm x 1 cm size at an angle of 90^o by gas welding on both sides. Neglect edge preparation cost and assume i) cost of oxygen =Rs $10/m^3$
   ii) cost of acetylene =Rs $60/m^3$
   iii) density of filler metal=7 gms/cc
   iv) cost of filler metal = Rs 12/kg
   from the table for 10mm thick plates
   i) O_2 consumption =0.7 m^3/hr
   ii) C_2H_2 consumption= 5mm
   iii) filler rod dia = 5mm
   iv) length of filler rod required=4.5 m/m of welding
   v)welding time = 30 min/m of welding
3. Estimate the welding material cost for making a rectangular frame for a gate of 2m x 1m from angle iron size 30mm x 30mm x 5mm. assume the following data:
   i) oxygen consumption=0.4 cu.m/hr which is available at Rs. 50/cu.m
   ii) acetylene consumption = 0.4 cu.m/hr which is available at Rs.50/cu.m
   iii) welding speed = 4 m/hr
   iv) length of filler rod of dia 2.5mm= 3.4 m/m of welding
   v) filler rod material cost = Rs.13/kg
   vi) welding is to be done on both sides
4. A cylinder boiler drum 3m x 1m dia is to be made from 1.5 thick MS plates. Both the ends are closed by welding circular plates to the drum. The cylindrical portion is welded along the longitudinal seam both inside and outside. Circular plates are welded only on outside. Determine the cost of electric arc welding using the following data:
   i) rate of welding 2m/hr on inside & 2.5 m/hr outside

ii) length of electrode required 2m/m of welding
iii) cost of electrode Rs. 6/- per meter
iv) power consumption 5 kwh per metre of weld
v) power charges Rs 2/- per unit
vi) labour charges Rs 10/hr
vii) overhead charges 200% of prime cost
viii) discarded electrodes -5%
ix) fatigue 7 setting up time -5% of welding time

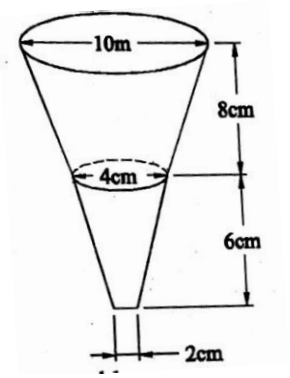
5. Two 1m long MS plates of 10mm thickness are to be welded by a lap joint with the help of a 6 mm electrode. Determine the cost of welding
   a. Current used :250 amp
   b. Voltage : 30 V
   c. Welding speed : 10m/hr
   d. Electrode used : 0.4 kg/m of welding
   e. Labour charges Rs 1/ hr
   f. Power charges Rs 0.20/kwh

   Cost of electrode Rs 5/kg

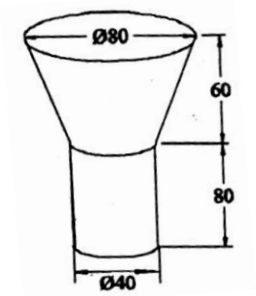
6. A container open on one side (top side) of size 0.5x0.5x1 m height is to be made from 5mm thick plate. Take the density of plate metal as 8 gms/cc. the joints one to be welded. Estimate the cost of the container from the following data

   Cost of plate =Rs. 12 per kg
   Sheet metal scrap = 5% of the material
   Cost of labour =10% of material cost
   Cost of welding material=Rs.30 per metre of weld
7. An open water tank 1mx1mx2.5m height is to be favricated from MS plates of 2.5cm thick. Estimate the cost of the tank from the following data.

   Density of MS =8gm/sec
   Cost of MS plate =Rs. 6/kg
   Cost of fabrication =25% of material cost
   Cost of welding =Rs. 0.25 per cm length
   Factory overhead charges= 30% of prime cost
   Sales overheads =20% of manufacturing cost
   Profit =25% of total cost.
8. A mild steel vessel 1m in dia and 2m in length is to be fabricated by using MS sheets of 5mm thick by welding on both sides. Sheets are available in sizes 1mX3m. estimate how many number of sheets required and the total quantity of the material required. Also Estimate, welding length, length of electrode, time required for welding for welding and power consumption. Use following data: density of MS=7.8 g/cc, rate of welding=1.5m/hour. Length of electrode=1.5m/m of weld, power consumption=4kwh per m of weld. Illustrate clearly with appropriate sheet layout to support your estimation.
9. Estimate the cost of metal sheet for preparing a funnel as show in figure. Assume the wastage of metal as 10% and cost of sheet as Rs.50/m^3.



10. Estimate the cost of metal sheet for preparing a funnel as shown in figure. Assume the stage of metal as 10% and cost of the sheet as Rs. 20/m^2 . all dimensions are in mm.



11. A cylinder drums of size 2.75 m height and 1.5m mean dia are to be fabricated from sheet of 5mm thickness by grooved seam joint and both the ends should be closed by sheet with single seam joint. Determine the material cost, if sheet is available at Rs. 2000/ m^2.

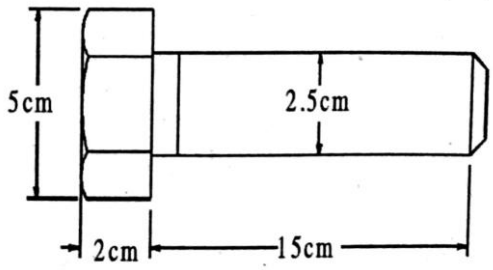
CO5: Ability to estimate the various forging & foundry shop components.

UNDERSTANDING

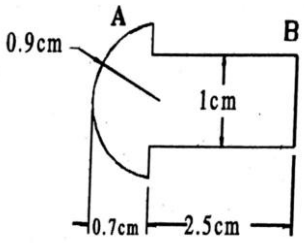
1. Explain the Cost terminology associated with forging shop.
2. Explain the procedure of calculating material cost of a product for forging shop
3. Explain the types of forging.
4. Explain the Procedure for estimating forging cost.
5. Explain the forging losses to be considered while estimating.
6. Explain the pattern allowances.
7. Explain the procedure for calculating material cost of a product for foundry shop.
8. Explain the procedure for estimating cost of pattern making.

APPLICATION

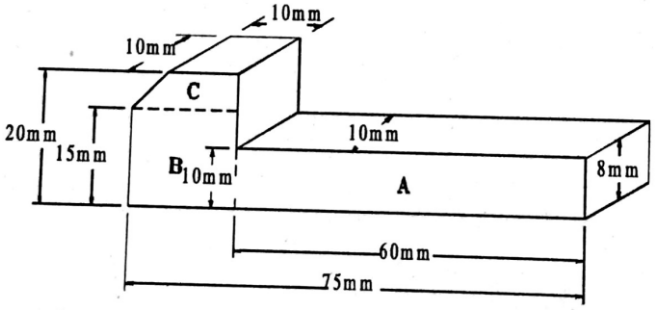
1. Prepare a hexagonal bolt 15mm diameter and 25cm length from a bar stock of 1.8 cm diameter. Determine the length of the bar stock required and also give the sequence of operations for forging the above bolt.
2. Estimate the size of stock and weight of material required to forge 100 MS bolts as shown in figure. The bar stock diameter is 3 cm.



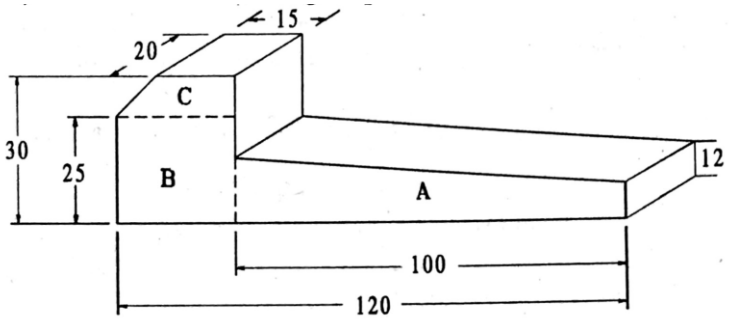
3. A hexagonal bolt 25mm dia and 200 mm length is to be forged from a bar stock of 30 mm dia. Determine the length of bar stock required if the total material loss is 15% of the net weight of the bolt. Hexagonal bolt head has 20 mm thickness.
4. Determine the gross weight of the MS bolt if it is produced in a lot of 5000. If steel weighs 7.9 gm/cm^3 and the method is upsetting. Also Determine the length of the bar required. Take spoilage loss as 10% of net weight, loss of scaling to be allowed as 5% of each component. The bolt is square headed bolt with head 40 square and height 15 mm, shank dia is 20mm, length 55mm. all dimensions are in mm.
5. Determine the length of 10 mm dia rod required to forge a ring of 50 mm inner dia. A scale loss of 5%.
6. A square bar of 3cm side and 25 cm length is to be converted by hand forging into a bar of hexagonal section having each side equal to 1.5cm. Determine the length of hexagonal bar produced; consider scale loss to be 7% of the total volume.
7. Estimate the length and weight of 1 cm dia stock required to hand forge 200 rivets of dimensions given in figure. Assume density of material as 8 gm/cc.



8. It is required to make a key of dimensions given figure. From a rod of 20mm dia. Determine the length of rod required on forging.



9. 300 pieces of gib headed key shown in figure are to be drop forged from a 4cm diameter bar. Determine the cost of material if
   i) material cost is Rs. 50/- per metre
   ii) scale loss 8%
   iii) shear loss as 3 mm length/piece

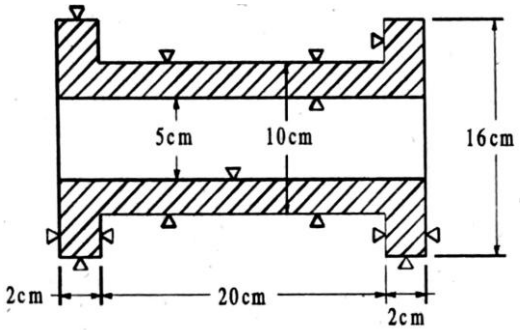


10. A finished drawing of a CI flanged pipe is given in figure. Your are required to prepare a wooden pattern in the pattern making shop. Estimate the quantity of wood required for manufacturing the pattern. Also estimate the cost of pattern if:

    a) wood is available at the rate of rs.2800 lm^3

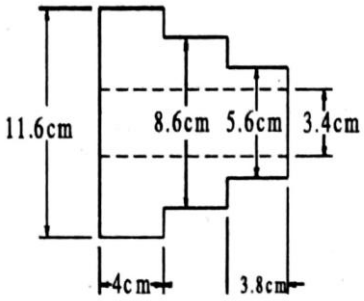
    b) pattern maker is available at the rate of Rs 80/ day and takes 6 hrs in preparing the pattern

    c) overhead charges are 20% of material cost.



11. Estimate the cost of 2000 CI pulleys as shown in figure. Its surfaces are to be machines after casting. The pattern is supplied by the customer itself. Following data can be used:

    Cost of metal = Rs.5/kg
    Moulds prepared by each worker/day=20
    Melting charges = 20% of metal cost
    Machining allowance on each side may be taken as 2mm
    Wages of each moulder =Rs. 16/day
    Density of CI = 7.2 gm/cc
    Overhead charges = 25% of metal cost.

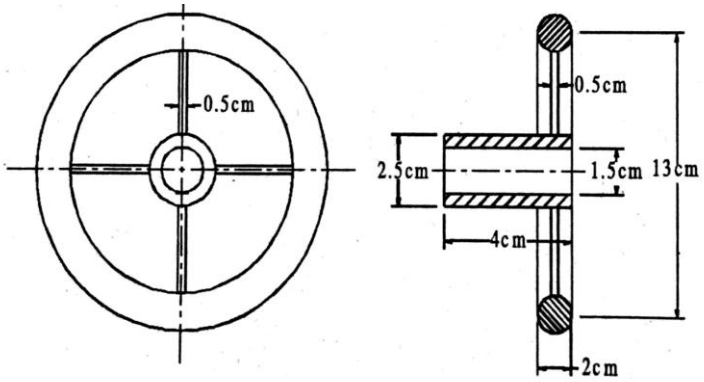


12. A manufacturer is willing to undertake the casting of 100 CI wheels shown in figure. Estimate the selling price of each wheel assuming the following:

    i) cost of pattern =Rs.40
    ii) process scrap = 10% of net weight
    iii) scrap return value = Rs.2.25/kg
    iv) cost if CI = Rs.5/kg
    v)administrative overgeads= Rs.2/piece

vi) selling overheads = 25% of production cost
vii) profit = 15% of total cost

unit operation	time	Rate/hour	Shop overheads
moulding	10 min	Rs. 3	Rs. 10/hr
pouring	6 min	Rs.2.50	Rs.8/hr
shot blasting	4min	Rs. 4.50	Rs.3.50/hr
fettling	5 min	Rs. 2.50	Rs. 3.00/hr



CO6: **Understand the concept of Process costing, and types of Budget, and familiarize with accounting terminology**

UNDERSTANDING

1. Explain the process costing.
2. Explain the characteristics of process costing.
3. List disadvantages and advantages of process costing
4. Explain the principles of process costing
5. Differentiate between job costing and process costing
6. Explain the procedure of process costing
7. Define a) nominal wages b) real wages c) fair wages d) minimum wages
8. Explain the concept of incentives
9. Explain different types of budget
10. Explain briefly: book value-Net Present Value-Work in progress- Gross Domestic Product (GDP)-balance sheet
11. Explain manual tendering
12. Explain E-tendering

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

Course Title: **COMPUTER INTEGRATED MANUFACTURING**		
Scheme (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15ME62T**
Type of Course: **Lectures, Self Study & Quiz**	Credit **:04**	Core/ Elective: **Core**

Prerequisites: Knowledge of basic mathematics and Applied Science, Engineering Graphics

Course Objectives:

The use of conventional machines is decreasing day by day. Evolution of information Technology, variety of manufacturing concepts with zero lead time demand and quality consciousness has supported fast adaption of Computer Aided Manufacturing.

Course Outcomes:

On successful completion of the course, the students will be able to attain CO:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Understand the principle of automation	***R/U/A***	2	**09**
CO2	Compare NC and CNC machines	***R/U/A***	2	**08**
CO3	Know the constructional features of CNC machines.	***R/U/A***	2	**10**
CO4	Construct part programmes using ISO format for given simple components	***R/U/A/An***	2	**12**
CO5	Develop an FMS (Flexible Manufacturing System) layout for given simple part family, using group technology concepts and familiarize with computer aided process planning	***R/U/A***	2	**07**
CO6	Recognize use of robotics, in the field of manufacturing.	***R/U/A***	2	**06**
		Total sessions		**52**

Legend: R: Remember U: Understand A: Application An: Analysis

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
CIM	0	3	0	0	0	0	0	0	0	0

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE/

Unit No	Unit Name	Hour	Questions to be set for SEE/Marks			Marks weightage	weightage (%)
			R	U	A/An		
1	Introduction to CIM& Automation	09	5	10	5	20	13.79
2	NC &CNC machines.	08	5	5	5	15	10.34
3	Constructional features of CNC machines.	10	10	15	10	35	24.13
4	CNC Part programming	12	5	15	20	40	27.58
5	Computer aided manufacturing	07	5	5	10	20	13.79
6	Robotics	06	5	5	5	15	10.34
	Total	52	35	55	55	145	100

Legend: R; Remember, U: Understand A: Application An: Analysis

UNIT I: INTRODUCTION TO CIM & AUTOMATION 09 Hrs

CIM – definition, scope and elements of CIM system-benefits, Production system facilities – low-medium-high-Manufacturing support systems-Automation in production systems-Automated manufacturing systems-Computerized Manufacturing Support Systems-Reasons for Automating, Automation principles and strategies-USA Principle-Ten Strategies for Automation and Production Systems, Automation –definition- Basic elements of an automated system - Levels of automation

UNIT II: NC AND CNC MACHINES 08 Hrs

Fundamentals of NC Technology- Basic Components of an NC System- NC Coordinate Systems- Motion Control Systems, Applications of NC- Machine Tool Applications- Other NC Applications- Advantages and Disadvantages of NC, Computer Numerical Control-Features of CNC- The Machine Control Unit for CNC- CNC Software, CNC Applications-Advantages and Disadvantages of CNC, DNC- Direct Numerical Control- Distributed Numerical Control

UNTIII: CONSTRUCTION OF CNC MACHINES 10Hrs

Construction of CNC machines-Machine structure- Static load-Dynamic load-Thermal load, Guide ways-Friction guide ways-V guide ways-Flat &dovetail guide ways-Cylindrical guide ways-Anti frictional linear motion guide ways, Feed drives-Servomotors-Mechanical transmission system, Spindle and spindle bearings-Hydrodynamic bearings-Hydrostatic bearings-Antifriction bearings, Measuring systems- direct & indirect measuring systems, Gauging, Tool monitoring-direct & Indirect monitoring, Automatic tool changer (ATC)-Automatic pallet changer (APC)

UNITIV: CNC PART PROGRAMMING 12 Hrs

Introduction to Part Programming-Coordinate system-Dimensioning-Axes & motion nomenclature Definition and importance of various positions like machine zero, home position, and work piece zero, CNC part programming- Structure of part programme-Word addressed format-Preparatory function(G)-Miscellaneous function(M)- Tool compensation-Subroutines (Macros)(L)-Canned cycles-Mirror image, Simple programme on Milling and Turning operations

UNIT V: GROUP TECHNOLOGY AND CAPP 07 Hrs

Group technology-Definition-Advantages and limitations of GT-Part family formation-Classification and coding-Opitz coding system, Applications & benefits of GT, Cellular manufacturing-Machining cell designs-Machining cell planning, Computer aided process planning-Approaches to CAPP-Implementation techniques-Essential elements in a retrieval type CAPP system-Essential elements in a generative CAPP system, Flexible manufacturing system-Scope of FMS-FMS compared to other types of manufacturing approaches-Types of FMS-Benefits of FMS-Major elements of FMS

UNIT VI: ROBOTICS 06Hrs

Introduction-definition of robot-Elements of a robotic system-Need for using robots-Types of robots-Classification of robots based on mechanical configuration-Gantry robot-SCARA robot-Freedom of motion, End effectors-grippers & tools, Drive systems, Control systems,

Performance capabilities-specifications-key feature, Programming robots-Programming methods, Applications of industrial robot.

TEXT BOOKS AND REFERENCE

S. No.	Title of Book	Author	Publication	Reference unit
1	Automation, Production Systems, and Computer-Aided Manufacturing	by Mikell P. Groover	Prentice-Hall International publication	**Introduction to CIM & Automation** / **NC and CNC machines**
2	Mechatronics	HMT limited	McGraw Hill Education	**Construction of CNC machines And CNC part programming. Group technology and CAPP**
3	CAD/CAM Principles and Applications	P N Rao	McGraw Hill Education	
5	CAD/CAM/CIM	P. Radhakrishnan, S. Subramanyan, V. Raju	New Age International Publishers	**Group technology and CAPP**
6	CNC Machines.	Pabla B.S., Adithan M.	New Age International, New Delhi,2014(reprint)	**Construction of CNC machines**
7	Computer Numerical Control-Turning and Machining centers.	Quesada Robert	Prentice Hall 2014	**CNC part programming**
8	CAD/CAM.	Sareen Kuldeep	S.Chand 2012.	**Group technology**
9	INDUSTRIAL ROBOTICS	Groover	McGraw Hill Education	**Robotics**

LIST OF SOFTWARES/ LEARNING WEBSITES:

i. http://www.nptel.ac.in
ii. http://www.youtube.com/watch?v=M3eX2PKM1RI
iii. http://www.youtube.com/watch?v=EHQ4QIDqENI&list=PLBkqkLQO2nAt5MNLo
iv. http://www.youtube.com/watch?v=hJFLcvtiNQ I
v. http://www.youtube.com/watch?v=BIM1AyxfYkw .
vi. http://www.mtabindia.com
vii. http://www.swansoftcncsimulator.com

SPECIAL INSTRUCTIONAL STRATEGIES

UNIT NO	UNIT NAME	STARATEGIES
1	**Introduction to CIM& Automation**	Videos, Presentations, Demonstration
2	**CNC machines.**	Videos, Presentations, Industrial Visits, Demonstration,
3	**Constructional features of CNC machines.**	Videos, Presentations, Industrial Visits, Demonstration,
4	**CNC Part programming**	Simulation software's, actual practice on

		CNC machines, Demonstration,
5	**Computer aided manufacturing**	Videos, Presentations, Industrial Visits, Demonstration,
6	**Robotics**	Videos, Presentations, Industrial Visits, Demonstration,

SUGGESTED LIST OF STUDENT ACTIVITYS

Note: the following activities or similar activities for assessing CIE (IA) for 5 marks (Any one)

- Each student should do any one of the following type activity or similar activity related to the course and before take up, get it approved from concerned Teacher and HOD.
- Each student should conduct different activity and no repeating should occur

1	Visit nearby industry having CNC machines. List and Recall important features of them. submit handwritten report of 500 words
2	Construct specifications of various types of CNC machines with images and names of manufacturers.
3	Download images and videos of CNC machines and its parts. Construct one VCD/DVD in a batch and submit them
4	Download free simulation software's available on website and practice for part programming.

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	Three IA tests(Average of three tests will be computed)	20	Blue books	1,2,3,4,5,6
				Student activities	05	Activity sheets	1,2,3,4,5,6
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

CIE- Continuous Internal Evaluation SEE- Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier**: **The following documents to be verified by CIE verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks evaluated through appropriate rubrics.
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS MODEL

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity.

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th week of VI sem 10-11 Am	VISEM	**COMPUTER INTEGRATED MANUFACTURING** **15ME62T**	20
	Year: 2016-17	Course code:15ME62T	

Name of Course coordinator : Units:1,2 CO: 1,2

Note: Answer all questions

Question no	Question	MARKS	CL	CO	PO
1	Compare between fixed, programmable and flexible automation system OR Explain the general configuration of Distributed Numerical Control system	05	A	1	2
2	List Ten Strategies for Automation and Production Systems	05	R	1	2
3	Compare between Point-to-Point Versus Continuous Path Control system OR Compare between Absolute Versus Incremental Positioning	05	A	2	2
4	Explain about Interpolation Methods	05	U	2	2

MODEL QUESTION PAPER

VI- Semester Diploma Examination

Course Title: **COMPUTER INTEGRATED MANUFACTURING**

Time: **3 Hours**] [Max Marks**: 100**

Note: Answer any **SIX from Part A** and any **SEVEN from Part B**

PART-A

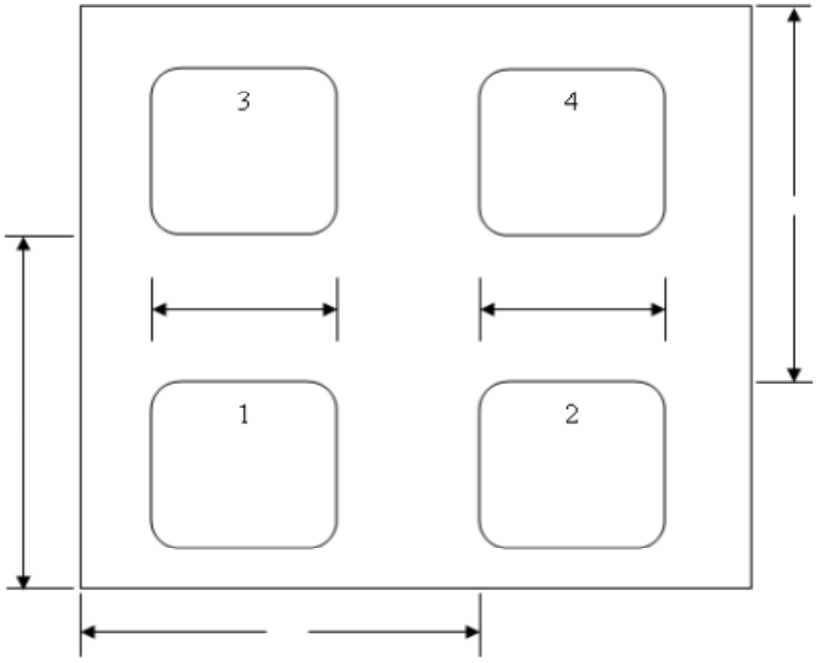
6x5=30 marks

1. Indentify the benefits of CIM
2. Explain flat and dovetail guide ways
3. Compare between direct and indirect measuring system
4. Compare between fixed, programmable and flexible automation system
5. Compare between Point-to-Point Versus Continuous Path Control system
6. Define cellular manufacturing and Explain its relevance in modern manufacturing
7. List out the key features and specifications required for improving the performance capability of a robot
8. Compare between tool length compensation and tool radius compensation
9. Identify the applications of group technology

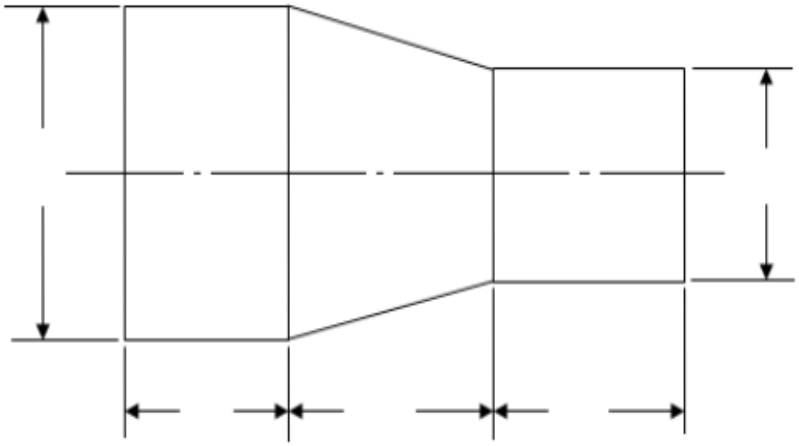
PART-B

7x10=70 marks

10. List the advantages and dis-advantages of CNC machines
11. Make use of sketch explain the working of Antifriction bearings
12. Explain the basic design factors involved in the design of a machine structure
13. Construct a part programme for the following component using sub routine shown in figure



14. Construct a part programme for the following component using sub routine shown in figure



15. Explain about the Opitz coding system generally used in group technology
16. Explain the methodology to be followed for developing a generative type of computer aided process planning system
17. Explain with sketch the SCARA robot
18. Explain with sketch a typical machine tool with an automatic pallet changer (APC)
19. Explain tool monitoring and tool gauging system
20. Explain programming of robots

****

MODEL QUESTION BANK

Diploma in Mechanical Engineering
VI Semester
Course title: COMPUTER INTEGRATED MANUFACTURING

Note: ***The paper setter is of liberty to set the questions on his/her desecration based on cognitive levels notified for that unit. They have to follow only blue print of SEE question paper format. The model question bank is only for reference to students/course coordinator to initiate the process of teaching-learning only.***

CO1: Understand the principle of automation

REMEMBERING

1. Define CIM and mention its needs.
2. Recall the reasons for automation

3. Define automation and mention its needs
4. List Ten Strategies for Automation and Production Systems

UNDERSTANDING

5. Explain Production system facilities
6. Explain low quantity production
7. Explain medium quantity production
8. Explain high quantity production
9. Explain automation in production systems
10. Explain Automated manufacturing systems
11. Explain manufacturing support systems
12. Explain computerized manufacturing support systems
13. Explain USA principle
14. Explain control system
15. Explain programme of instructions
16. Explain about the main elements of CIM system
17. Explain the information-processing cycle in a typical manufacturing firm.
18. Compare between fixed, programmable and flexible automation system
19. Explain about basic elements of an automated system
20. Explain about the five levels of automation

APPLICATION

21. Indentify the benefits of CIM
22. Identify the scope of CIM

CO2: Compare NC and CNC machines

REMEMBERING

1. Recall the NC Interpolation Methods for Continuous Path Control
2. List Machine Tool Applications of NC system
3. List the advantages and disadvantages of NC system
4. Define Computer Numerical Control system and Recall its needs in manufacturing
5. List the Features of CNC
6. List the three types of CNC Software
7. List the advantages and disadvantages of CNC system

UNDERSTANDING

8. Explain three basic components of an NC System
9. Explain NC Coordinate Systems
10. Explain about Interpolation Methods
11. Explain Direct Numerical Control system
12. Explain Distributed Numerical Control system
13. Illustrate the general configuration of Direct Numerical Control system
14. Illustrate the general configuration of Distributed Numerical Control system
15. Compare between Point-to-Point Versus Continuous Path Control system

16. Compare between Absolute Versus Incremental Positioning.
17. Compare between linear and circular interpolation methods
18. Explain the configuration of CNC machine control unit.

APPLICATION

1. Choose the Applications of CNC system
2. Choose the Applications of NC system

CO3: Know the constructional features of CNC machines

REMEMBERING

1. List the important parts and aspects of CNC machines to be considered in their designing.
2. List the important factors to be considered while designing guide ways
3. Recall the necessity of antifriction linear motion guide ways used in CNC machine tools
4. List commonly used feed drive motors for CNC machines and Explain direct current servo motors
5. List two types of mechanical transmission system and Recall the main criterion to be considered in the design of a mechanical transmission system
6. List the various types of spindle bearings used in the design of a spindle for machine tools.
7. List the methods of measuring system
8. List the requirements for tool changing activity
9. List the requirements to operate the automatic tool changer

UNDERSTANDING

10. Explain static load, dynamic load and thermal load in machine structure
11. Explain frictional guide ways
12. Explain Vee guide ways
13. Explain flat and dovetail guide ways
14. Explain cylindrical guide ways
15. Explain the principle of hydrodynamic bearings
16. Explain the principle of hydrostatic bearings
17. Explain the principle of Antifriction bearings
18. Explain gauging in CNC machines
19. Explain tool monitoring system
20. Explain tool magazines
21. Explain the basic design factors involved in the design of a machine structure
22. Explain about elements used to convert the rotary motion to a linear motion
23. Explain about torque transmission elements

24. Compare between direct and indirect measuring system
25. Compare between direct and indirect monitoring system
26. Explain about tool changing

APPLICATION

27. Make use of sketch explain a typical machine tool with an automatic pallet changer (APC)
28. Identify the function of measuring systems which are used in CNC machines
29. Choose the functions of guide ways

CO4: Construct part programmes using ISO format for given simple components

REMEMBERING

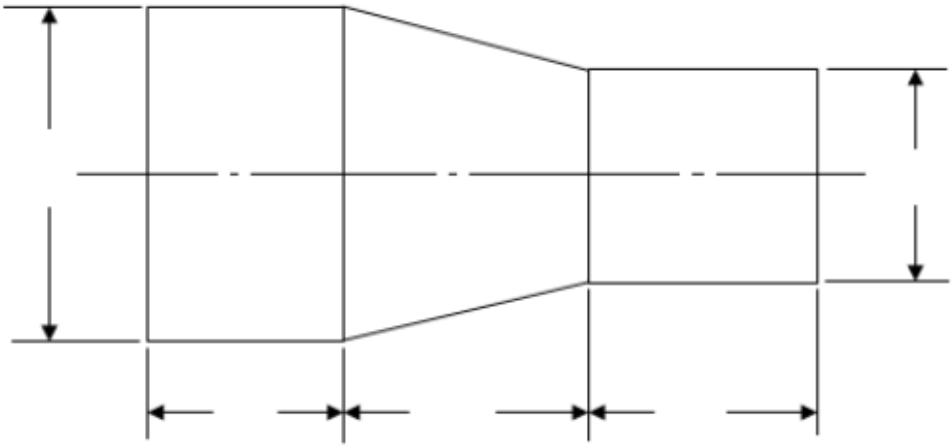
1. Define CNC part programming
2. Choose the function of automatic tool changers in CNC machine tools

UNDERSTANDING

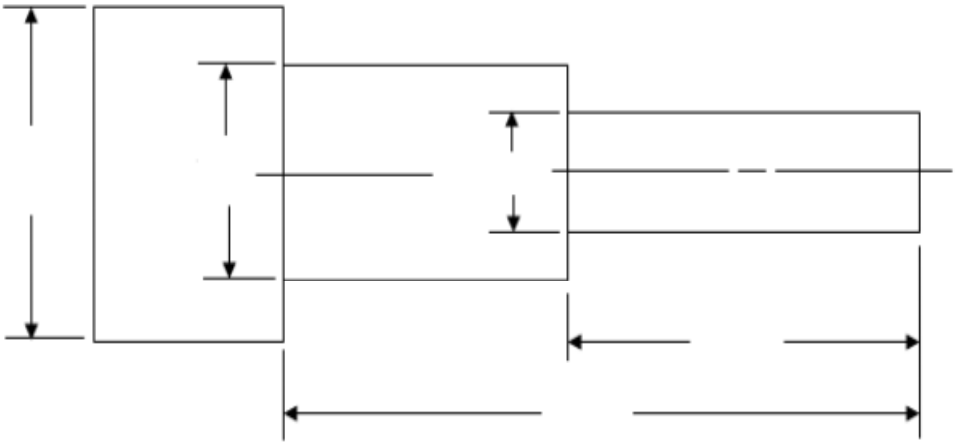
3. Explain the factors to be considered while writing the CNC part program.
4. Explain the co-ordinate system and methods of dimensioning.
5. Explain the various positions like machine zero, home position, and work piece zero.
6. Explain word addressed format.
7. Explain commonly used preparatory and miscellaneous functions for turning.
8. Explain commonly used preparatory and miscellaneous functions for milling
9. Illustrate the circular interpolation using interpolation parameters
10. Illustrate the circular interpolation by specifying the radius
11. Compare between tool length compensation and tool radius compensation
12. Illustrate subroutines (macros) (L)
13. Illustrate canned cycles using any one code from (G81-G89)
14. Illustrate mirror image
15. Explain axes and motion nomenclature.

APPLICATION/ANALYSIS

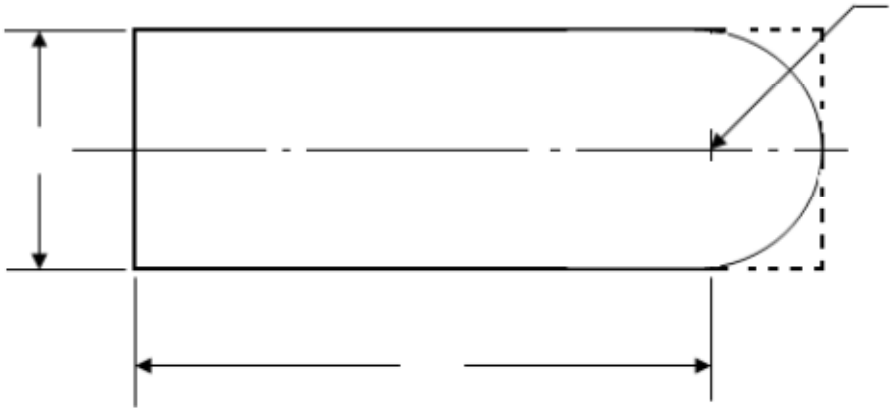
16. Make use of block diagram write the structure of part program.
17. Construct Simple programme on Milling and Turning operations
18. Construct a part programme for the following component shown in figure



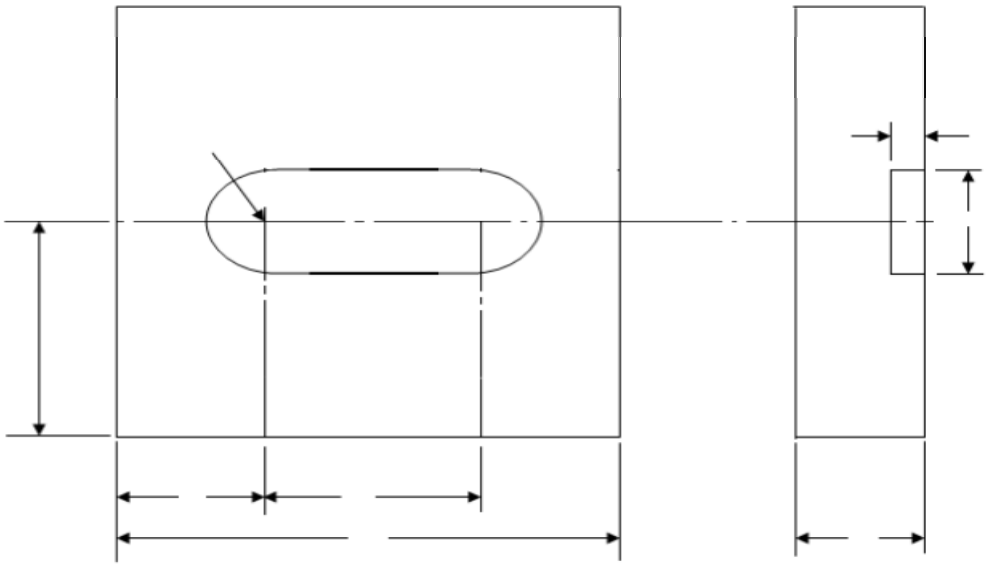
18. Construct a part programme for the following component shown in figure



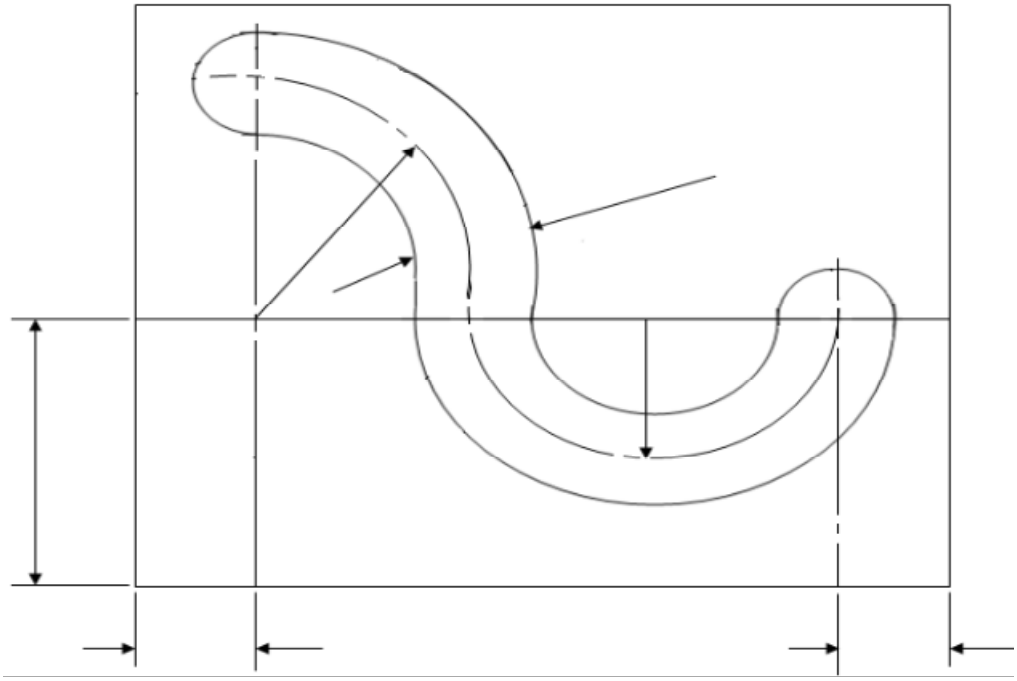
19. Construct a part programme for the following component shown in figure



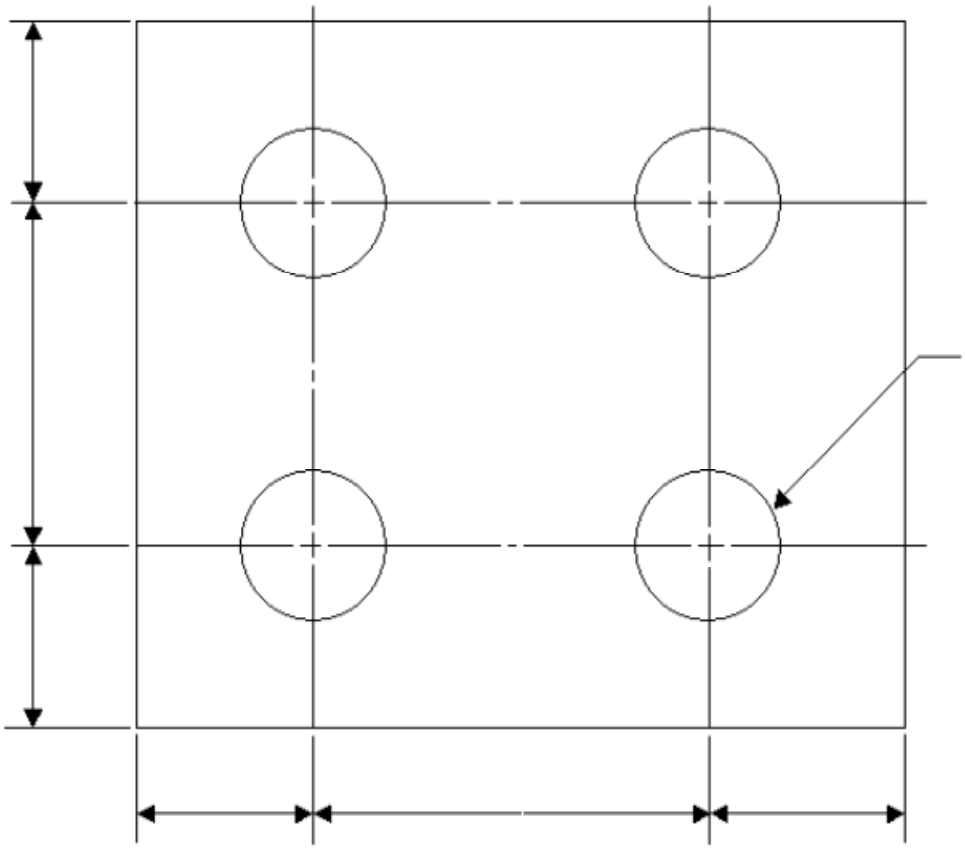
20. Construct a part programme for the following component shown in figure



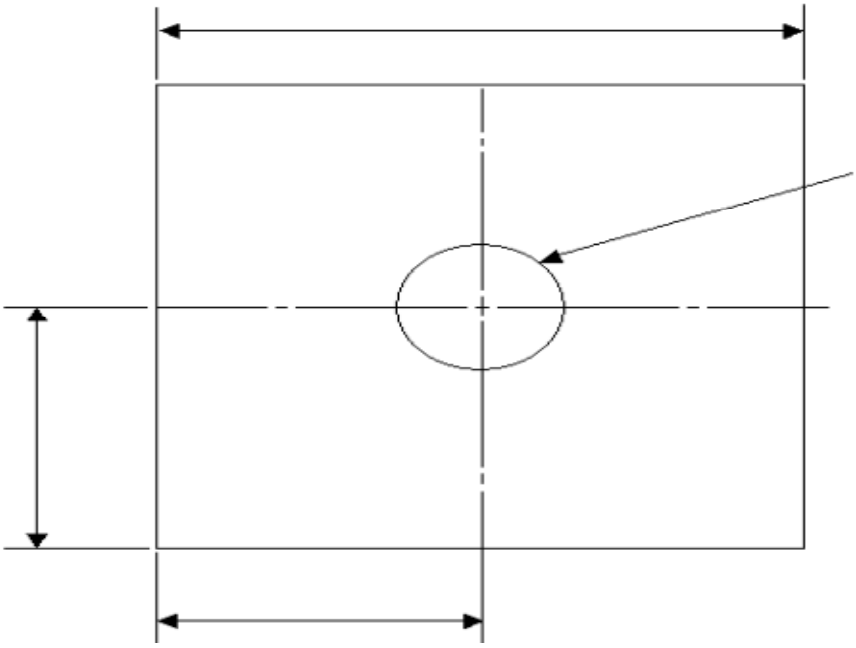
21. Construct a part programme for the following component shown in figure



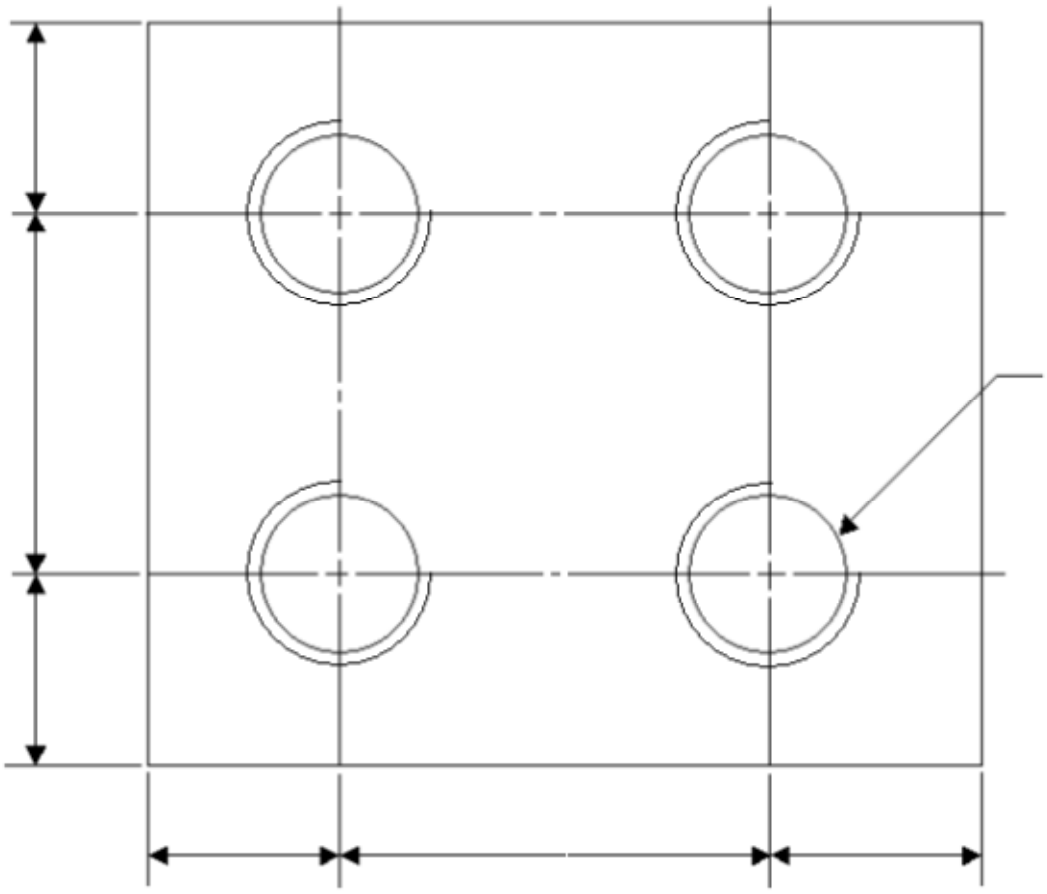
22. Construct a part programme for the following component shown in figure



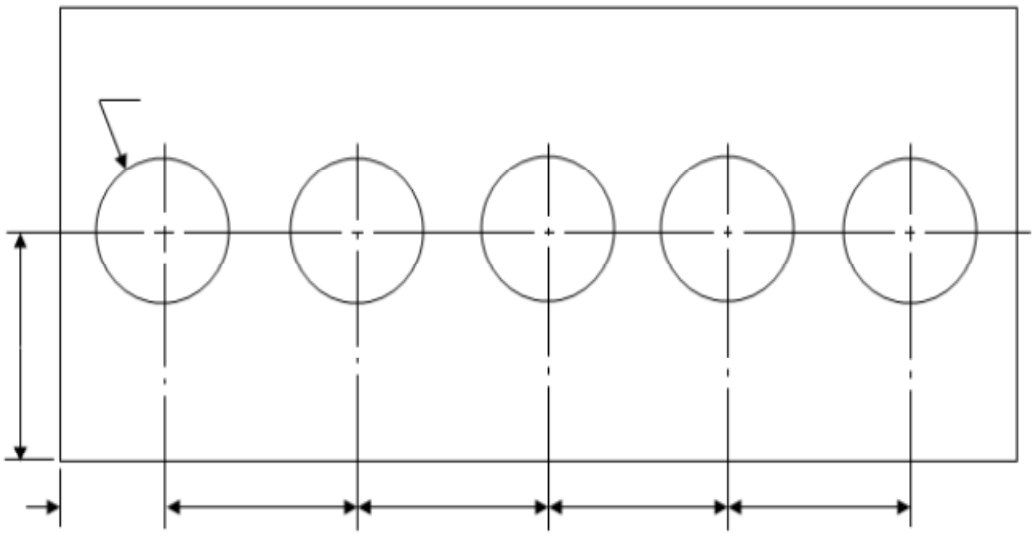
23. Construct a part programme for the following component shown in figure



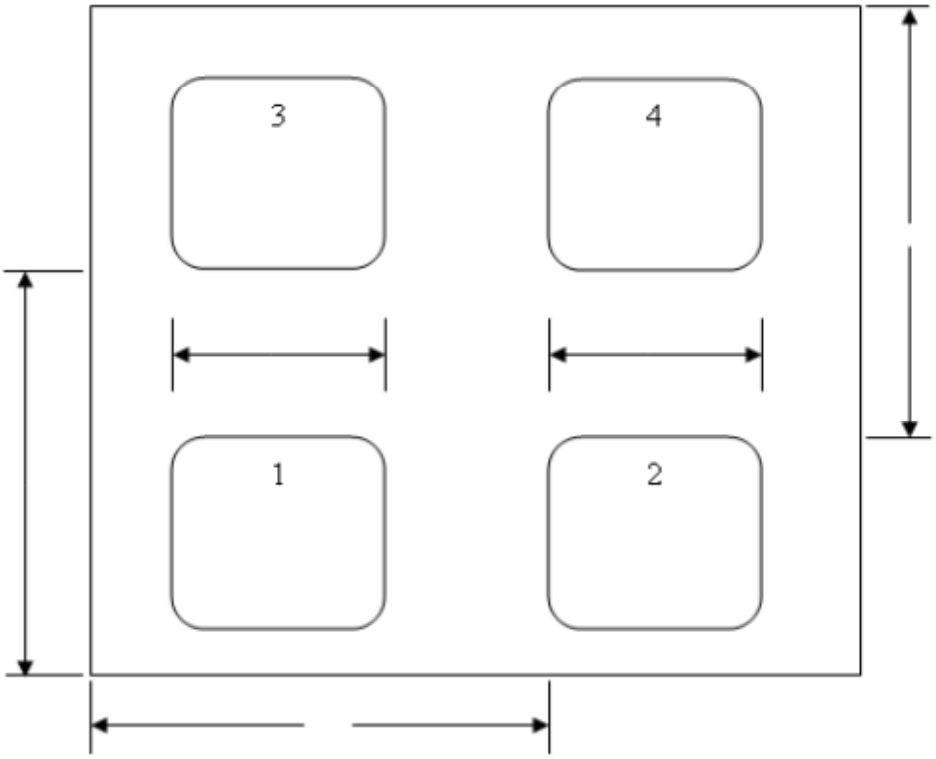
24. Construct a part programme for the following component shown in figure



25. Construct a part programme for the following component using do-loops shown in figure



26. Construct a part programme for the following component using sub routine shown in figure



CO5: Develop an FMS (Flexible Manufacturing System) layout for given simple part family, using group technology concepts and familiarize with computer aided process planning

REMEMBERING

1. List and explain the different methods available for forming groups in group technology
2. List the functions of classification and coding system
3. List the types of coding systems
4. List the applications of group technology
5. Define cellular manufacturing and Explain its relevance in modern manufacturing
6. List and explain the machining cell designs

UNDERSTANDING

7. Explain the importance of group technology in present manufacturing scenario
8. Explain group technology
9. Explain about the Opitz coding system generally used in group technology
10. Explain the needs for computer aided process planning
11. Explain the retrieval type of computer aided process planning method
12. Explain the generative type of computer aided process planning method
13. Explain the methodology to be followed for developing a retrieval type of computer aided process planning system
14. Explain the methodology to be followed for developing a generative type of computer aided process planning system
15. Explain the need for FMS
16. Explain the importance of material handling system in FMS

17. Explain the types of materials handling devices used in a FMS
18. Compare between retrieval type and generative type of computer aided process planning
19. Compare FMS to other types of manufacturing approaches

APPLICATION

20. Identify the benefits of group technology
21. Choose the major elements of FMS
22. Identify the benefits of FMS
23. Identify the advantages and limitations of group technology

CO6: Recognize use of robotics, in the field of manufacturing.

REMEMBERING

1. Define robot and explain its needs in computer integrated manufacturing
2. List the significant advantages of using a robot in a computer integrated manufacturing
3. List the different types of robots
4. Recall the different types of drive systems used in robots.
5. Recall the different types of end effectors
6. Recall and explain the different types of control systems used in robots
7. List out the key features and specifications required for improving the performance capability of a robot

UNDERSTANDING

8. Explain the functions of mechanical components in robotic system
9. Explain rectangular co-ordinate robots
10. Explain cylindrical co-ordinate robots
11. Explain spherical co-ordinate robots
12. Explain revolute co-ordinate robots
13. Explain types of grippers used in industrial robot
14. Explain tools used in industrial robots as a end effectors
15. Explain programming of robots
16. Explain the methods used for program the robots
17. Explain the classifications of robots based on mechanical configuration
18. Compare between a SCARA and a gantry robot
19. Explain about six degrees of freedom in order to get the motions in robots.
20. Explain about the major functions of a control system used in robots
21. Explain about applications of industrial robot

APPLICATION

1. Make use of sketch explain the Gantry robot

2. Make use of sketch explain the SCARA robot
3. Choose the elements of a robotic system
4. Identify the important benefits of robots in CIM
5. Choose the functions of robot in computer integrated manufacturing

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

	Course Title: **AUTOMOBILE ENGINEERING**		
	Scheme (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15ME63A**
	Type of Course: **Lectures, Self Study & Quiz**	Credit **:04**	Core/ Elective: **Elective**

Prerequisites: Knowledge of Science, Work shop technology, Thermal engineering, Mechanics of Machines, EM & SOM.

Course Objectives:

To understand & apply the knowledge about various system, subsystems & their inter-relationships of the automobile for the manufacturing of advanced automotive techniques

Course Outcomes:

On successful completion of the course, the students will be able to attain CO:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Know the different types of automobiles, basic structure of automobile and their manufacturers in India. Understand the basic engine system working	***R/U/A***	2	**10**
CO2	Understand the transmission of power in automobile	***R/U/A***	2	**10**
CO3	Familiarise with fuel supply to automobile and understand the cooling system	***R/U/A***	2	**08**
CO4	Explain the steering and braking system employed in automobiles	***R/U/A***	2	**08**
CO5	Explain the different suspension system of an automobile and selection of tyre for an automobile	***R/U/A***	2	**10**
CO6	Explain the Electrical and ignition system employed in Automobile	***R/U/A***	2	**06**
		Total sessions		**52**

Legend: R; Remember, U: Understand A: Application

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
AUTOMOBILE ENGINEERING	0	3	0	0	0	0	0	0	0	0

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.
Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

Unit No	Unit Name	Hour	Questions to be set for SEE/Marks			Marks weightage	weightage (%)
			R	U	A		
1	AUTOMOBILE ENGINE SYSTEM	10	5	15	10	30	20.68
2	TRANSMISSION SYSTEM	10	5	15	10	30	20.68
3	FUEL SYSTEMS & COOLING SYSTEM	08	5	10	-	15	10.34
4	CONTROL SYSTEM	08	5	5	10	20	13.81
5	SUSPENSION SYSTEMS, WHEELS & TYRES	10	5	10	10	30	20.68
6	AUTOMOBILE ELECTRICAL SYSTEMS	06	5	5	10	20	13.81
	Total	52	30	65	50	145	100

Legend: R; Remember, U: Understand A: Application

UNIT I: AUTOMOBILE ENGINE SYSTEM 10 HRS

Automobile-definition, types of auto mobiles-Major components of automobile-functions of automobile components-manufacturer of motor vehicles in India- automotive vehicles and their historical development. Engine -Main parts of engine-Cylinder block- Cylinder head-Piston- Connecting rod- Crank shaft- Crankcase- Cam shaft- Flywheel-Engine maintenance-dis-mounting of engine-Engine disassembly-Inspection of engine components-engine reassembly

UNIT II: TRANSMISSION SYSTEM 10 HRS

Clutch- Main parts-types of clutch- construction & working of Single plate clutch - diaphragm spring type clutch-Gear Box- Types of Gear box-construction & working of Sliding mesh Gear box-synchromesh Gear box-Constant mesh Gear box, Transmission devices- Torque converter, Overdrive, Final drive- Propeller shaft, Universal Joint - Differential-necessity-construction & working- Axle- Types of rear axle, front axle & their applications- Automatic Transmission System.

UNIT III: FUEL SYSTEMS & COOLING SYSTEM 08 HRS

Fuel supply system for petrol engine- Carburettor-Simple carburettor- fuel pump- AC Mechanical pump-SU Electrical pump- DTSI (Digital Twin Spark Ignition System)

Fuel injection for diesel engine-Fuel injection pump- - microprocessor based fuel injection system- CRDI (Common Rail Direct Injection) System.

Engine lubrication systems- High pressure Lubrication system- Petroil System

Engine cooling system -The necessity of cooling system - Types of cooling system-air cooling and water cooling. Types of water cooling system –Thermosyphon system and pump circulation system. Advantages and disadvantages of air cooling and water cooling systems. The components of water cooling system

UNIT IV: CONTROL SYSTEM 08 HRS

Steering system- Functions & Requirement of steering system. Construction and working of steering linkage. Steering gear box –Rack & Pinion Steering mechanism-Power steering - steering geometry- camber, caster, toe-in, toe-out, Kingpin inclination & their effects. Brake system- Types of brakes- Internal expanding brake - Disc brake- Hydraulic Brake.- Anti-lock braking system(ABS)

UNIT V: SUSPENSION SYSTEMS, WHEELS & TYRES. 10 HRS

Suspension system-Need for good suspension system-elements of suspension system-Leaf Springs-Helical Springs - Construction & working of McPherson & wishbone type –Air Suspension System- Construction & working of Telescopic shock absorbers-Types of Automobile wheels, their construction & working- essential requirements of wheels - Construction, working & comparison of radial, cross-ply and tubed, tubeless tyre -Tyre specifications-Factors affecting tyre life-Wheel Alignment and Balancing

UNIT VI: AUTOMOBILE ELECTRICAL SYSTEMS 06 HRS

Auto electric system-main components of auto electric system-Ignition system- construction & working of electronic ignition system-Battery ignition system- Magneto ignition system, Starting system- Charging system.

Lighting system - Power door locks features- Smart Wiper Control System - Air bags features used in automobiles.

TEXT BOOKS

Sl.No.	Title of Books	Author	Publication
1.	Automobile Engineering	Kirpal Singh	Standard Publication
2.	Automobile Engineering. (Developed at NITTTR,Bhopal)	K.K.jain R.B.Asthana	Mcgraw Hill
3.	Automobile Engineering	R.B.Guptha	-
4	Automobile Mechanics	William Crouse	Tata Mcgraw hill
5	Automotive Mechanics	Joseph Hitner	
6	Automobile Engineering	G.S.Narang	Khanna publishers

1. , LIST OF SOFTWARES/ LEARNING WEBSITES:

i. http://nptel.ac.in/courses/112105051/

ii download other power plant related videos from youtube.com for study purpose.

SPECIAL INSTRUCTIONAL STRATEGIES

UNIT NO	UNIT NAME	STARATEGIES
1	AUTOMOBILE ENGINE SYSTEM	lectures and Power point presentations/ Video/ Video movies
2	TRANSMISSION SYSTEM	Lectures/Presentations, Showing charts, Industrial visits to Automobile work shops
3	FUEL SYSTEMS & COOLING SYSTEM	Lectures/Presentations, Showing charts, Industrial visits to Automobile work shops
4	CONTROL SYSTEM	Lectures/Presentations, Showing charts, Industrial visits to Automobile work shops
5	SUSPENSION SYSTEMS, WHEELS & TYRES	Lectures/Presentations, Showing chart,
6	AUTOMOBILE ELECTRICAL SYSTEMS	Lectures/Presentations, Showing charts, Industrial visits to Automobile work shops

SUGGESTED LIST OF STUDENT ACTIVITYS

Note: the following activities or similar activities for assessing CIE (IA) for 5 marks (Any one)

- Each student should do any one of the following type activity or similar activity related to the course and before take up, get it approved from concerned Teacher and HOD.
- Each student should conduct different activity and no repeating should occur

1	Prepare list of various major automobile manufacturers of Two wheeler sand fourwheelers in India, along with their specification
2	Prepare report on Top 10 Car/MUV/2W/Heavy vehicle Manufacturers in India & their sale in last 2 Years.
3	Collect the detail specification on Top 5 models of Car Manufactured in India
4	Download technical specifications/ catalogues, videos or any other suitable presentations on Automobile engines used in four wheelers
5	Download technical specifications/ catalogues, videos or any other suitable presentations on Automobile tyres/Power steering/Suspension system
6	Visit to four- wheeler service station & any automobile manufacturing unit. Prepare hand written report on aspects they observed in service station

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	Three IA tests(Average of three tests will be computed)	20	Blue books	1,2,3,4,5,6
				Student activities	05	Activity sheets	1,2,3,4,5,6
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

CIE- Continuous Internal Evaluation SEE- Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks and should be assessed on RUBRICS
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods.

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS MODEL

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Method

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th week of sem 10-11 Am	VI SEM	AUTOMOBILE ENGG	20
	Year: 2016-17	Course code:**15ME63A**	

Name of Course coordinator : Units:1,2 Co: 1,2

Note: Answer all questions

Question no	Question	MARKS	CL	CO	PO
1	a. Name the manufacturers of motor vehicles in India. b. List the functions of piston rings	**5**	**R**	**1**	2
2	Explain with sketch compression ring and oil control rings	**5**	**U**	**1**	2
3	Explain the Automatic Transmission System	**5**	**U**	**2**	2
4	Identify the role of Automatic Transmission system in automobile industry.	**5**	**A**	**2**	2

MODEL QUESTION PAPER

VI- Semester Diploma Examination

Course Title: **AUTOMOBILE ENGG**

Time: **3 Hours**] [Max Marks**: 100**

Note: Answer any **SIX from Part A** and any **SEVEN from Part B**

PART-A

6x5=30 marks

1. Define piston and List its functions
2. Explain the construction and functions of cylinder block
3. Compare between live axle and dead axle
4. Explain torque convertor with a neat sketch
5. Compare between water cooling and air cooling system
6. What are the requirements of steering mechanism
7. List the factors affecting the tyre life.
8. List the types of lights used in automobiles.
9. Explain the working of Battery ignition system with a neat sketch.

PART-B

7x10=70 marks

1. a) List the functions of cylinder head gasket.
   b) Explain the construction and working of piston
2. Select the different steps for dismounting of the engine.
3. a) Explain front axle and mention its applications
   b) Explain the Automatic Transmission System
4. Explain synchromesh Gear box with a neat sketch
5. a) Explain with sketch the construction and working principle of simple carburettor
   b) Explain CRDI System
6. Identify the necessity of the steering geometry with diagrams
7. a) Explain telescopic shock absorbers with a neat sketch
   b) Explain the elements of suspension system
8. Identify the importance of wheel alignment and balancing in a vehicle
9. Develop a Block diagram of Auto electrical system and explain.
10. Explain the working of SU Electrical pump with a neat sketch

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MODEL QUESTION BANK

Diploma in Mechanical Engineering
VI Semester
Course title: AUTOMOBILE ENGG

Note: ***The paper setter is of liberty to set the questions on his/her desecration based on cognitive levels notified for that unit. They have to follow only blue print of SEE question paper format. The model question bank is only for reference to students/course coordinator to initiate the process of teaching-learning only.***

CO1: know the different types of automobiles, basic structure of automobile and their manufacturers in india. Understand the basic engine system working

REMEMBERING

1. List the types of automobiles.
2. Name the manufacturers of motor vehicles in India.
3. List the main components of an engine
4. What is the importance of cylinder liners in an engine.
5. Name the different types of gaskets used in automobile engines
6. Define piston and mention its functions
7. List the functions of piston rings
8. What is the purpose of camshaft in an engine.
9. What is the importance of flywheel in an engine.
10. List the steps to be followed for engine disassembly
11. List the causes for reboring a cylinder.

UNDERSTANDING

1. Explain the automotive vehicles and their historical development.
2. Explain the construction and functions of cylinder block.
3. Explain the dry liners with sketch.
4. Explain with the wet liners sketch.
5. Compare between dry liners and wet liners.
6. Explain crankcase with a neat sketch.
7. Explain with sketch the cylinder head.
8. Explain the functions of cylinder head gasket.
9. Explain the construction and working of piston
10. Explain with sketch compression ring and oil control rings
11. Explain with sketch connecting rod
12. Explain the functions of a crank shaft with a neat sketch
13. Explain engine maintenance.

APPLICATION

1. Identify the main components used in an automobile.
2. Identify the functions of major components used in automobile engine.

3. Select the different steps for safe dismounting of the engine.

CO2 : Understand the transmission of power in automobile

REMEMBERING

1. What is the purpose of Clutch.
2. List the types of Clutches.
3. List the different types of gear boxes.
4. List the functions of Clutches
5. What is overdrive unit.
6. List the advantages of overdrive unit.

UNDERSTANDING

1. Explain the working of single plate clutch with a neat sketch.
2. Explain the diaphragm spring type clutch with a neat sketch.
3. Explain the working of Sliding mesh Gear box with a neat sketch
4. Explain the working of synchromesh Gear box with a neat sketch
5. Explain torque convertor with a neat sketch.
6. Explain final drive with its purpose.
7. Explain universal joints with its purpose
8. Explain Propeller shaft with its necessity.
9. Explain differential with a neat sketch.
10. Explain front axle and mention its applications
11. Explain the Automatic Transmission System.
12. Compare between live axle and dead axle.
13. Explain different types of rear axle with sketches.

APPLICATION

1. Identify the importance of spring type clutch with a neat sketch.
2. Identify the role of synchromesh Gear box to control speed with a neat sketch.
3. Identify the role of Automatic Transmission system in automobile industry.
4. Identify the necessity of overdrive unit in transmission system.

CO3: Familiarise with fuel supply to automobile and understand the cooling system

REMEMBERING

1. List the properties of air-fuel mixture
2. Define engine lubrication system and list its types.
3. Define engine cooling system and list its types.
4. List the parts of cooling system.
5. List the properties of Lubricating oil.

UNDERSTANDING

1. Explain Fuel system for petrol engine with block diagram (Layout).
2. Explain the working of AC Mechanical pump with a neat sketch.
3. Explain the working of SU Electrical pump with a neat sketch.
4. Explain with sketch the construction and working principle of simple carburettor.
5. Explain Fuel system for petrol engine with block diagram (Layout).
6. Explain fuel injection pump for diesel engine with sketch.
7. Explain DTSI System.
8. Explain CRDI System.
9. Explain water cooling system with sketch.
10. Explain air cooling system with sketch.
11. Compare between water cooling and air cooling system.

APPLICATION

1. Identify the importance of microprocessor based fuel injection system.
2. Develop a line diagram for fuel supply system for petrol engine.

CO4: Explain the steering and braking system employed in automobiles

REMEMBERING

1. List the functions of steering mechanism.
2. What are the requirements of steering mechanism.
3. Define a)Camber, b)Caster, c)Toe-in, d)Toe-out, e)Kingpin inclination
4. List the types of brakes.

UNDERSTANDING

1. Explain Construction and working of steering linkage with a neat sketch.
2. Explain Construction and working of steering gear box with a neat sketch.
3. Explain Construction and working of rack and pinion Steering mechanism with a neat sketch
4. Explain Construction and working of Power Steering mechanism with a neat sketch
5. Explain Construction and working of Drum brake with a neat sketch
6. Explain Construction and working of internal expanding brake with a neat sketch
7. Explain Construction and working of disc brake with a neat sketch
8. Explain Construction and working of Hydraulic Brake with a neat sketch
9. Explain Anti-lock braking system.
10. Compare Disc brake & drum brake.

APPLICATION

1. Identify the necessity of the steering geometry with diagrams.
2. Identify the role of steering linkage in steering mechanism.

CO5: Explain the different suspension system of an automobile and selection of tyre for an automobile

REMEMBERING

1. List the elements of suspension system.
2. List the types of Automobile wheels.
3. List the essential requirements of wheels.
4. List the factors affecting the tyre life.

UNDERSTANDING

1. Explain the elements of suspension system.
2. Explain leaf spring with a neat sketch.
3. Explain Coil spring with a neat sketch.
4. Explain telescopic shock absorbers with a neat sketch
5. Explain pressed steel disc wheels
6. Explain telescopic Wire spoke wheels.
7. Explain telescopic Cast light alloy wheels.
8. Explain radial tyre.
9. Explain cross-ply tyre.
10. Explain tubed tyres.
11. Explain tubeless tyres.

APPLICATION

1. Identify the importance of a suspension system in a vehicle.
2. Making use of a sketch explain McPherson suspension system.
3. Making use of a sketch explain wishbone suspension system.
4. Identify the importance of wheel alignment and balancing in a vehicle.

CO6: Explain the electrical and ignition system employed in automobile

REMEMBERING

1. List the main components of Auto electrical system.
2. List the types of lights used in automobiles.

UNDERSTANDING

1. Explain the working of electronic ignition system with a neat sketch.
2. Explain the working of Battery ignition system with a neat sketch
3. Explain the working of Magneto ignition system with a neat sketch
4. Explain Starting system.
5. Explain Charging system.
6. Explain Power door locks features used in automobile system.
7. Explain Smart Wiper Control System used in automobile system
8. Explain Air bags features used in automobiles.

APPLICATION

1. Develop a Block diagram of Auto electrical system and explain.
2. Identify the importance of air bags in an automobile.

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

	Course Title: **POWER PLANT ENGINEERING**		
	Scheme (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15ME63B**
	Type of Course: **Lectures, Self Study & Quiz**	Credit **:04**	Core/ Elective: **Elective**
CIE: 25 Marks			SEE:100 Marks

Prerequisites: Knowledge of Mathematics, Thermodynamics, Mechanics of machines, Work shop technology, Fluid mechanics and machinery.

Course Objectives:

Apply knowledge of mechanical engineering related to power generation systems, their control and economics in different type of power plants for their operation and maintenance.

Course Outcomes:

On successful completion of the course, the students will be able to attain CO:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Analyze economics of power plants and list factors affecting the power plants and interpret the performance of power plants based on load variations	***R/U***	2	**05**
CO2	Identify elements and their functions of, hydro power plants.	***R/U/A***	2	**10**
CO3	Identify elements and their functions and operations of steam power plants.	***R/U/A***	2	**10**
CO4	Identify elements and their functions and operations of nuclear and gas turbine power plants	***R/U/A***	2	**10**
CO5	Identify elements and their functions and operations of Solar, wind and diesel power plants	***R/U/A***	2	**09**
CO6	Know the Social and Economical issues of power plants	***R/U***	2,5,6,7	**08**
		Total sessions		**52**

Legend: R: Remember U: Understand A: Application

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
POWER PLANT ENGINEERING	**0**	**3**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.
Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

Unit No	Unit Name	Hour	Questions to be set for SEE/Marks			Marks weightage	weightage (%)
			R	U	A		
1	INTRODUCTION & ECONOMICS OF POWER PLANT	05	5	5	-	10	7
2	HYDRO POWER PLANT	10	5	10	15	30	21
3	THERMAL POWER PLANT	10	5	10	10	25	17
4	NUCLEAR POWER PLANT & GAS TURBINE POWER PLANTS	10	10	10	10	30	21
5	SOLAR, WIND AND DIESEL POWER PLANTS.	09	5	15	10	30	21
6	PLANT SAFETY AND ENVIRONMENTAL IMPACT OF POWER PLANT	08	5	15	-	20	13
	Total	52	35	65	45	145	100

Legend: R; Remember, U: Understand A: Application

UNITI: INTRODUCTION & ECONOMICS OF POWER PLANT 5 Hrs

Power plant-Introduction, Classification - Location of power plant- Choice of Power plant- Terminology used in power plant: Peak load, Base load, Load factor, Load curve, demand factor- Various factor affecting the operation of power plant- Load sharing- cost of power- tariff methods-factors involved in fixing of a tariff.

UNIT II: HYDRO POWER PLANT 09 HRS

Hydro electric power plant- Introduction, storage and poundage, Selection of sites for hydro electric power plant-General layout and essential elements of Hydro electric power plant and its working-Classification of the plant- base load plant, peak load plant, Run off river plant, storage river plant, pumped storage plant, mini and micro hydel plants, governing of

hydraulic turbines-impulse turbine- reaction turbine, selection of turbines, Advantages and disadvantages-limitations of hydro electric power plant.

UNT III: THERMAL POWER PLANT 11 HRS

Thermal power plant -General layout – working-Site Selection–materials required for thermal power plants, coal handling and its methods, stages in coal storage, Fuel burning-Stoker firing-overfeed stoker –under feed stokers-chain grate stoker, Pulverized fuel handling system-unit and central system, Pulverization of coal-Ball mill, Ash handling system- Gravity system- electrostatic precipitation (ESP) system-Feed water treatment- Mechanical method, Advantages and disadvantages-limitations of Thermal power plant.

UNITIV: NUCLEAR POWER PLANT & GAS TURBINE POWER PLANTS 10 HRS

Nuclear power plant-introduction-nuclear fuels, nuclear fission and fusion, working of a nuclear power plant, types of reactors- pressurized water reactor- boiling water reactor, effects of nuclear radiation, different methods for nuclear waste disposal-low, medium and high level waste disposal, Advantages -disadvantages- limitations.

Gas turbine power plant- Schematic diagram & working of open and closed cycle gas turbine power plant, Components of Gas turbine–compressor, combustion chamber, gas turbine, vortex blading, gas turbine fuels, Gas turbine power plants in India - Namrup & Uran gas turbine power plants. Advantages -disadvantages- limitations of Gas turbine power plant

UNITV: SOLAR, WIND AND DIESEL POWER PLANTS. 9 HRS

Solar power plant-introduction-layout, Solar cell fundamentals & classification – maximum power point tracker (MPPT) and solar panel.
Wind power plant: introduction, -Factors affecting distribution of Wind energy, Variation of wind speed with height and time-Horizontal axis wind turbine (HAWT)-types of rotors-Vertical axis wind turbine- types of rotors- Wind energy conversion system (WECS) advantages and disadvantages-limitations of Wind power plant.
Diesel power plant- layout -Components and the working- Advantages -disadvantages-limitations.

UNIT VI: PLANT SAFETY AND ENVIRONMENTAL IMPACT OF POWER PLANT 08 Hrs

Social and Economical issues of power plant- Oxides of sulphur- oxides of carbon-oxides of nitrogen, Acid precipitation-Acid rain- acid snow- Dry deposition-acid fog, green house effect, air and water pollution from thermal power plants and its control, Thermal pollution from thermal power plants, noise pollution and its control, natural and artificial radio activity-nuclear power and environment- radiations from nuclear power plant effluents- high level wastes- methods to reduce pollution, global warming- its effects and control, standardization for environmental pollution.

TEXT BOOKS AND REFERENCE BOOKS

Sl.No.	Title of Books	Author	Publication
1.	Power plant engineering	Arora and Domkundwar	Dhanpat rai & CO (P) LTD
2.	Power plant engineering	P. K. Nag	McGraw Hill
3.	Power plant engineering	G. R. Nagpal	Khanna publishers
4.	Power Plant Engineering.	Dr. P. C. Sharma	S. K. Kataria
5.	A Text Book of Power Plant Engineering.	R K Rajput	Laxmi Publications,
6	Power plant technology	M.M. EL-Wakil	McGraw Hill
7	Power Plant Engineering.	C. Elanchezhian, L. Saravanakumar, B. Vijaya Ramnath	I.K. International Publishing House
8	Power Station Engineering and Economy.	Bernhardt G A Sarotzki, William A Vopat	Tata Mc Graw Hill
9	Nuclear Power Plant Engineering.	James H. Rust	Haralson Publishing Company
10	Steam power plant engineering.	Louis Allen Harding	J. Wiley & Sons, inc
11	Power Plant Engineering	A K Raja, Amit Prakash Srivastava and Manish Dwivedi	New age international Publishers

LIST OF SOFTWARES/ LEARNING WEBSITES:

i. http://nptel.ac.in/courses/112105051/
ii. https://www.youtube.com/watch?v=Ota2_LUuar0
iii. https://www.youtube.com/watch?v=Ota2_LUuar0
iv. https://www.youtube.com/watch?v=3dJAtHaSQ98
v. https://www.youtube.com/watch?v=xokHLFE96h8
vi. http://www.tatapower.com/businesses/renewable-energy.aspx
vii. http://www.cleanlineenergy.com/technology/wind-and-solar
viii. https://www.youtube.com/watch?v=kbuLfXgw4Gs
ix. https://www.youtube.com/watch?v=r9q80sSHxKM
x. https://www.youtube.com/watch?v=GZKKWz_tX1c
xi. download other power plant related videos from youtube.com for study purpose .

SPECIAL INSTRUCTIONAL STRATEGIES

UNIT NO	UNIT NAME	STARATEGIES
1	**Introduction & economics of power plant**	Videos, Presentations, Discussions
2	**Hydro power plant**	Videos, Presentations, Industrial Visits, Demonstration,
3	**Thermal power plant**	Videos, Presentations, Industrial Visits, Demonstration,
4	**Nuclear power plant & gas turbine power plants**	Videos, Presentations, Industrial Visits, Demonstration
5	**Solar, wind and diesel power plants.**	Videos, Presentations, Industrial Visits, Demonstration,
6	**Plant safety and environmental impact of power plant**	Videos, Presentations, Industrial Visits, Demonstration,

SUGGESTED LIST OF STUDENT ACTIVITYS

Note: the following activities or similar activities for assessing CIE (IA) for 5 marks (Any one)

- Each student should do any one of the following type activity or similar activity related to the course and before take up, get it approved from concerned Teacher and HOD.
- Each student should conduct different activity and no repeating should occur

1	Prepare list of various major power plants installed in Karnataka along with their total capacity.
2	Prepare charts of different high pressure boilers, gas turbine cycles, steam turbine power plant, wind turbine power plant, solar power plant, etc. on half imperial drawing sheet. Attach the same with term work.
3	Visit websites of NTPC, BHEL,, NHPC, NPCIL, GEDA, SUZLON, GE, SIEMENS, ENERCON and KPC etc and find out the technical information about their machineries or Plants.
4	Download technical specifications/ catalogues, videos or any other suitable presentations on gas turbine power plant
5	Download technical specifications/ catalogues, videos or any other suitable presentations on Hydro power plant.
6	Visit diesel power plant available in your institute/ nearer to your institute and understand different elements, working, circuits, and specifications.

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	Three IA tests(Average of three tests will be computed)	20	Blue books	1,2,3,4,5,6
				Student activities	05	Activity sheets	1,2,3,4,5,6
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

CIE- Continuous Internal Evaluation SEE- Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks evaluated through appropriate rubrics.
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS MODEL

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

4. Blue books (20 marks)
5. Student suggested activities report for 5 marks
6. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Method

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th week of sem 10-11 Am	IVSEM	POWER PLANT ENGINEERING	20
	Year: 2016-17	Course code:15ME63B	

Name of Course coordinator : Units:1,2 Co: 1,2

Note: Answer all questions

Question no	Question	MARKS	CL	CO	PO
1	List the various factors considered for location of power plants OR Explain a) Peak load b) Base load	05	R	1	2
2	Explain load sharing.	05	U	1	2
3	Explain with a neat sketch the governing of impulse turbine.	05	U	2	2
4	Explain the storage river plant, pumped storage plant.	05	U	2	2

MODEL QUESTION PAPER

IV- Semester Diploma Examination

Course Title: **POWER PLANT ENGINEERING**

Time: **3 Hours**] [Max Marks**: 100**

Note: Answer any **SIX from Part A** and any **SEVEN from Part B**

PART-A

6x5=30 marks

1. Define a) Peak load b) Base load
2. List the various factors affecting the operation of power plant
3. List the advantages and disadvantages of hydro electric power plants
4. List the advantages of gas turbine power plant with nuclear power plant
5. List the Factors affecting distribution of Wind energy.
6. List the advantages of wind power plant
7. List Social and Economical issues related to power plants
8. List the limitations of nuclear power plant.
9. List the fuels used in thermal power plant.

PART-B

7x10=70 marks

1. Explain Demand factor and Load curve
2. Explain the various considerations while calculating cost of electrical energy.
3. Make use of Sketch explain the layout of hydro power plant
4. Make use of Sketch explain ash handling system
5. Make use of Sketch explain electrostatic precipitation (ESP) system
6. Explain the various methods involved in disposing of nuclear wastes
7. Explain briefly about green house effect.
8. Explain briefly about radiations from nuclear power plant effluents.
9. Explain with a neat sketch unit and central pulverizing systems.
10. Make use of Sketch explain the line diagram nuclear power plant

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MODEL QUESTION BANK

Diploma in Mechanical Engineering
IV Semester
Course title: POWER PLANT ENGINEERING

Note: ***The paper setter is of liberty to set the questions on his/her desecration based on cognitive levels notified for that unit. They have to follow only blue print of SEE question paper format. The model question bank is only for reference to students/course coordinator to initiate the process of teaching-learning only.***

CO1 Analyze economics of power plants and list factors affecting the power plants and interpret the performance of power plants based on load variations

R-Remember

1. Define power plant
2. List the source of energy
3. List classifications of Power plants
4. List the various factors considered for location of power plants
5. List the various factors affecting the operation of power plant
6. List the principal factors involved in fixing of tariff

U-Understanding

11. Explain with reasons for considering the various factors in identifying the plant locations
12. Explain the importance of load curve in power generation
13. Explain Power plant economics
14. Explain Various factor affecting the operation of power plant
15. Explain Demand factor and Load curve
16. Explain load factor and Demand factor
17. Explain the various types of electrical energy tariffs
18. Explain the choice of power plant
19. Explain load sharing.
20. Explain various considerations while calculating cost of electrical energy.
21. Explain Power plant economics
22. Explain i) Demand factor ii) Load curve
23. Explain i) load factor ii) Demand factor
24. Explain a) Peak load b) Base load

CO2: Identify elements and their functions of, hydro power plants.

REMEMBERING

1. List the essential components of hydro electric power plant.
2. List the different types of hydroelectric power plant
3. List the advantages and disadvantages of hydro electric power plants
4. List the different factors to be considered while selecting the site for hydroelectric power plant.

UNDERSTANDING

1. Explain briefly the necessity of storage and poundage.
2. Explain a typical layout of a hydro electric plant.
3. Explain briefly the essential elements of a hydroelectric power plant.
4. Explain briefly the working the hydroelectric power plant.
5. Explain the base load plant, peak load plant and Run off river plant.
6. Explain the mini and micro hydel plants.
7. Explain with a neat sketch the governing of impulse turbine.
8. Explain with a neat sketch the governing of reaction turbine.
9. Explain briefly the factors involved in selection of turbines

APPLICATION

1. Make use of the Sketch, explain the storage river plant, pumped storage plant
2. Make use of the Sketch, explain the layout of hydrol power plant

CO3: Identify elements and their functions and operations of steam power plants

REMEMBERING

1. List the fuels used in thermal power plant.
2. List the classification of fuel firing.

UNDERSTANDING

3. Explain briefly the working of thermal power plant.
4. Explain the various factors considered for site selection for thermal power plant.
5. Explain different basic materials required for thermal power plants.
6. Explain the different methods of coal handling systems.
7. Explain methods used for coal storage.
8. Explain the principle of overfeed and underfeed stokers.
9. Explain with a neat sketch chain grate stokers.
10. Explain with a neat sketch unit and central pulverizing systems.
11. Explain briefly pulverizing of coal
12. Explain with a neat sketch mechanical feed water treatment.
13. Explain with a neat sketch ball mill.
14. Explain feed water treatment process.

APPLICATION

14. Make use of the Sketch, explain the general layout modern thermal power plant.
15. Make use of the Sketch, explain ash handling system
25. Make use of the Sketch. explain Gravity system
26. Make use of the Sketch ,explain electrostatic precipitation (ESP) system

CO4: Identify elements and their functions and operations of nuclear and gas turbine power plants..

REMEMBERING

1. Define nuclear fusion and nuclear fission
2. Name the different nuclear fuels used for nuclear power plant
3. List the advantages and limitations of nuclear power plant.
4. List the components of gas turbine power plant
5. List the advantages of gas turbine power plant with nuclear power plant
6. List the advantages and limitations of open cycle and closed cycle gas turbine

UNDERSTANDING

1. Compare between nuclear fusion and fission.

2. Explain with a neat sketch nuclear power plant.
3. Explain pressurized water reactor (PWR) with a neat sketch.
4. Explain with a neat sketch boiling water reactor (BWR).
5. Explain the effects of nuclear radiation on environment.
6. Explain briefly low, medium and high level waste disposals.
7. Explain with a neat sketch open cycle gas turbine power plant.
8. Explain with a neat sketch closed cycle gas turbine power plant.
9. Explain with a neat sketch the following components of gas turbine
   a) Compressor b) Combustion chamber,
10. Explain with a neat sketch the following components of gas turbine
   a) Gas turbine b) Vortex blading

APPLICATION

1. Choose the various methods involved in disposing of nuclear wastes
2. Make use of the sketch explain closed cycle gas turbine power plant
3. Make use of the sketch explain open cycle gas turbine power plant
4. Make use of the sketch explain the line diagram nuclear power plant

CO5: Identify elements and their functions and operations of solar, wind and diesel power plants

REMEMBERING

1. Define solar period
2. List the Factors affecting distribution of Wind energy.
3. List the advantages of wind power plant
4. List and explain the types of rotors for HAWT.
5. List and explain the types of rotors for VAWT
6. List the Advantages and disadvantages of diesel power plant

UNDERSTANDING

1. Classify the different types of solar cells.
2. Explain briefly about solar cells.
3. Explain maximum power point tracker (MPPT).
4. Explain solar panel.
5. Explain the Variation of wind speed with height and time.
6. Explain with a neat sketch Horizontal axis wind turbine (HAWT).
7. Explain with a neat sketch vertical axis wind turbine(VAWT)
8. Explain with a neat sketch Wind energy conversion system (WECS).

APPLICATION

1. Make use of the Sketch, explain a layout of diesel power plant.
2. Make use of the Sketch, explain the various Components of diesel power plant.
3. Make use of the Sketch, explain working of diesel power plant.

CO6: Know the Social and Economical issues of power plant

REMEMBERING

1. List Social and Economical issues related to power plants.
2. List the reasons for air pollutions due to power plant
3. List the water pollutants arise due to power plant
4. List the methods to control global warming by power plants.
5. List the methods suggested for developing the power plant without pollution

UNDERSTANDING

1. Explain about Acid precipitation, Acid rain and acid snow.
2. Explain about Dry deposition and acid fog.
3. Explain briefly about green house effect.
4. Explain the various water and air pollution caused by thermal power plants and its control.
5. Explain about noise pollution caused by power Discuss about Thermal pollution from thermal power plants.
6. Explain briefly about natural and artificial radio activity.
7. Explain briefly about radiations from nuclear power plant effluents.
8. Explain briefly about high level wastes and their disposal.
9. Explain the contribution of power plants for global warming and its effects
10. Explain the purpose of standardization of environmental pollution.
11. Explain the measure to be taken by power plants to avoid air pollution
12. Explain the measure to be taken by power plants to avoid water pollution
13. Explain the measure to be taken by power plants to avoid Noise pollution

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

	Course Title: **RENEWABLE ENERGY RESOURCES**		
	Scheme (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15ME63C**
	Type of Course: **Lectures, Self Study & Quiz**	Credit **:04**	Core/ Elective: **Elective**
CEE:25 Marks			SEE:100 Marks

Prerequisites: Knowledge of Applied science, Thermal engineering

Course Objectives:

The energy has become an important and one of the basic infrastructures for the economic development of the country. it is imperative for the sustained growth of the economy. This course envisages the new and renewable source of energy, available in nature and to expose the students on sources of energy crisis and the alternates available, also stress up on the application of non-conventional energy technologies.

Course Outcomes:

On successful completion of the course, the students will be able to attain CO:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Understand the need of energy conversion and the various methods of energy storage	**R/U/A**	2	**08**
CO2	Explain the field applications of solar energy	**R/U/A**	2,6	**12**
CO3	Identify Winds energy as alternate form of energy and to know how it can be tapped	**R/U/A**	2,6	**11**
CO4	Explain bio gas generation and its impact on environment	**R/U/A**	2,6	**06**
CO5	Understand the Geothermal &Tidal energy, its mechanism of production and its applications	**R/U/A**	2,6	**07**
CO6	Illustrate the concepts of Direct Energy Conversion systems & their applications.	**R/U/A**	2,6	**08**
		Total sessions		**52**

Legend: R: Remember U: Understand A: Application

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
RENEWABLE ENERGY RESOURCES	0	3	0	0	0	2	0	0	0	0

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

Unit No	Unit Name	Hour	Questions to be set for SEE/Marks			Marks weightage	weightage (%)
			R	U	A		
1	ENERGY CONSERVATION& STORAGE	08	5	10	10	25	17.24
2	SOLAR ENERGY	10	5	15	10	30	20.68
3	WIND ENERGY	08	5	5	10	20	13.80
4	BIO MASS ENERGY	08	5	5	10	20	13.80
5	GEO THERMAL & TIDAL ENERGY	10	5	15	10	30	20.68
6	DIRECT ENERGY CONVERSION SYSTEMS	08	5	5	10	20	13.80
	Total	52	30	55	60	145	100

Legend: R; Remember, U: Understand A: Application

UNIT I: ENERGY CONSERVATION & STORAGE 08 Hrs

Energy- Energy Sources & their Availability - Importance of Renewable Energy Resources - Principles of energy conservation- Energy storage- Necessity of energy storage-Energy storage methods- Mechanical Energy storage -Pumped storage-Compressed air storage-Electrical Storage -Lead Acid Battery -Chemical Storage -Energy storage via hydrogen - Electromagnetic energy storage.

UNIT II: SOLAR ENERGY 10 HRS

Solar energy - Introduction-Solar constant- Solar Radiation at the Earth's surface-measurements of solar radiation-pyronometer- pyrheliometer- sunshine recorder –Solar collectors-Classification-liquid flat plate collector-construction-effect of various parameter on its performance-Concentrating collector-Focusing and non-focusing type-Applications of

Solar Energy - solar water heater- Solar Cooker-Box type- Solar dryer-solar greenhouse—Summer and winter greenhouse-solar electric power generation-Solar photovoltaic.

UNIT III: WIND ENERGY 08 HRS

Introduction- Basic Principles of Wind energy conversion-The nature of wind- The power in the wind (No derivations)- Forces on the Blades (No derivations)-Site Selection considerations-Basic components of a wind energy conversion system (WECS)-Advantages & Limitations of WECS-Wind turbines (Wind mill)-Horizontal Axis wind mill-Vertical Axis wind mill-performance of wind mills-Environmental aspects

UNIT IV: BIOMASS ENERGY 08 Hrs

Introduction- Biomass conversion techniques-Biogas Generation-Factors affecting biogas Generation-Types of biogas plants- Advantages and disadvantages of biogas plants-urban waste to energy conversion-MSW incineration plant.

UNIT V: GEO THERMAL & TIDAL ENERGY. 10 HRS

Geothermal Sources-Hydro thermal Sources- a. Vapor dominated systems b. Liquid dominated systems -Prime movers for geothermal energy conversion-Tidal Energy-Basic Principles of Tidal Power-Components of Tidal Power Plants- Schematic Layout of Tidal Power house-Advantages & Limitations of Tidal power.

UNITVI: DIRECT ENERGY CONVERSION SYSTEM 08 Hrs

Thermo - Electric power- Basic Principles-Thermo electric power generator-Thermionic Generation –Introduction-Thermionic emission & work function-Basic Thermionic generator-Chemical Energy Sources-Introduction-Fuel cells – Principles of operation, classification & Types-Applications of fuel cells.

TEXT BOOKS

Sl.No.	Title of Books	Author	Publication
1.	Non-Conventional energy sources.	G.D.Rai	Khanna Publishers
2.	Non-Conventional energy sources-2 E	B.H.Khan	Tata McGraw Hill
3.	Renewable Energy Sources & Emerging Technologies.	D P Kothari, K C Singal&RakeshRanjan	Prentice Hall India
4	Solar energy.	H.P.Garg	McGraw Hill-Education
5.	Energy opportunities and social responsibility.	Satyesh C. Chakraborty	Jaico publications

LIST OF SOFTWARES/ LEARNING WEBSITES:

i. http://nptel.ac.in/courses/112105051/
ii. https://www.youtube.com/watch?v=Ota2_LUuar0
iii. https://www.youtube.com/watch?v=Ota2_LUuar0
iv. https://www.youtube.com/watch?v=3dJAtHaSQ98
v. https://www.youtube.com/watch?v=xokHLFE96h8
vi. http://www.tatapower.com/businesses/renewable-energy.aspx
vii. http://www.cleanlineenergy.com/technology/wind-and-solar
viii. https://www.youtube.com/watch?v=kbuLfXgw4Gs
ix. https://www.youtube.com/watch?v=r9q80sSHxKM
x. https://www.youtube.com/watch?v=GZKKWz_tX1c
xi. download other power plant related videos from youtube.com for study purpose.

SPECIAL INSTRUCTIONAL STRATEGIES

UNIT NO	UNIT NAME	STARATEGIES
1	**Energy conservation& storage**	lectures and Power point presentations/ Video/ Video movies
2	**Solar energy**	Lectures/Presentations, Showing charts, Video movies, Industrial visits to solar Installation units
3	**Wind energy**	Lectures/Presentations, Showing charts, Video movies, Industrial visits to wind mills
4	**Bio mass energy**	Lectures/Presentations, Showing chart, Industrial visits to nearby Bio mass plant
5	**Geo thermal & tidal energy**	Lectures/Presentations, Showing chart,
6	**Direct energy conversion systems**	Lectures/Presentations, Showing chart, Expose to real life industries situation, industrial visits

SUGGESTED LIST OF STUDENT ACTIVITYS

Note: the following activities or similar activities for assessing CIE (IA) for 5 marks (Any one)

- Each student should do any one of the following type activity or similar activity related to the course and before take up, get it approved from concerned Teacher and HOD.
- Each student should conduct different activity and no repeating should occur

1	Prepare a of monthly energy consumption of your institute and find the ways how it can be conserved
2	Conduct an energy audit of your institute; suggest the ways how the conventional energy resources utilization can be minimized. Suggest the areas ,where the non-conventional energy may be used
3	Identify the solar intensity and wind speed in your institute locality and calculate the intensity of Solar/Wind Power can be generated.
4	Visit to web site of ministry of renewable energy ,Government of India: http://mnre.gov.in/ make a Study on 'Developmental Impact and Sustainable Governance aspects of Renewable Energy Projects'
5	Visit solar power plant /wind power plant available in your locality/ nearer to your institute and understand different elements, working, and note the power generation by these plants

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	Three IA tests(Average of three tests will be computed)	20	Blue books	1,2,3,4,5,6
				Student activities	05	Activity sheets	1,2,3,4,5,6
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

CIE- Continuous Internal Evaluation SEE- Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks and should be assessed on RUBRICS
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods.

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS MODEL

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity.

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th weak of sem 10-11 Am	VI SEM	**RENEWABLE ENERGY RESOURCES**	20
	Year: 2016-17	Course code:15ME63C	

Name of Course coordinator : Units:1,2 Co: 1,2

Note: Answer all questions

Question no	Question	MARKS	CL	CO	PO
1	List out the primary and secondary energy sources OR What are the categories of energy storage system.	5	R	1	2,6
2	Explain lead acid battery, with a neat sketch	5	U	1	2,6
3	Define solar collectors and list the types of collectors	5	R	2	2,6
4	1. Identify the sources of commercial energy. OR 1. Analyse, the sun tracking helps in energy collection by a flat plate solar collector.	5	A	1,2	2,6

MODEL QUESTION PAPER

VI- Semester Diploma Examination

Course Title: **RENEWABLE ENERGY RESOURCES**

Time: **3 Hours**] [Max Marks**: 100**

Note: Answer any **SIX from Part A** and any **SEVEN from Part B**

PART-A 6x5=30 marks

1. What is the necessity of energy conservation and list its various aspects.
2. List the advantages and disadvantages of wind turbines
3. Identify the applications and advantages of flat plate collector.
4. List the usable forms of biomass, their composition and fuel properties
5. Explain the five categories geothermal sources
6. List the advantages and disadvantages of fuel cells
7. Explain solar greenhouse
8. Explain hydro thermal sources
9. Explain briefly about bio diesel plants

PART-B 7x10=70 marks

1. Explain the various aspects of energy conservation.
2. Explain about the solar collectors and its types
3. Explain the forces acting on wind blades.
4. Explain with a neat sketch fixed dome digester
5. Compare the relative performances of a floating drum and fixed dome type biogas plants.
6. Explain with a neat sketch basic thermo ionic generator.
7. Select the considerations for site to install tidal energy .
8. Illustrate the seeded inert gas system with a neat sketch.
9. Making use of a sketch explain the single basic arrangement of tidal power generation.
10. Explain with a neat sketch seeded inert gas system.

****

MODEL QUESTION BANK

Diploma in Mechanical Engineering
IV Semester
Course title: MECHANICS OF MACHINES

CO1: understand the need of energy conversion and the various methods of energy storage

REMEMBERING

1. Define primary and secondary energy sources.
2. Define Renewable and non renewable energy sources.
3. List out primary and secondary energy sources.
4. List the various Renewable and non renewable energy sources.
5. List the advantages and limitations of conventional energy sources.
6. List the advantages and limitations of non conventional energy sources.
7. List the categories of energy storage system.

UNDERSTANDING

1. Explain conventional energy sources.
2. Explain the concept of renewable energy
3. Explain the primary and secondary sources and their availability.
4. Explain the importance of renewable energy sources compared to Non renewable energy sources.
5. Explain the necessity of energy conservation and its various aspects.
6. Explain various principles of energy conservation.
7. Explain energy storage concepts and list the devices available.
8. Explain the necessity of energy storage system
9. Explain pumped hydro-electric energy storage system with a schematic diagram.
10. Explain compressed air storage system with a schematic diagram.
11. Explain lead acid battery, with a neat sketch.
12. Explain chemical energy storage via hydrogen.

APPLICATION

2. Develop the per-capita energy consumption related with standard of living.
3. Identify the sources of commercial energy.
4. Identify the necessity of energy conservation and Explain its various aspects

CO2 : Explain the field applications of solar energy

REMEMBERING

1. Define solar constant.
2. Define beam, diffused and global radiation
3. Define solar irradiance, solar constant, extra terrestrial and terrestrial radiations

4. Define solar collectors and list the types of collectors.
5. List the applications of flat plate collector.
6. Label the different parts of a parabolic collector with a neat sketch.
7. List the advantages and disadvantages of concentrating collector over flat plate collector.
8. List the advantages and disadvantages of flat plate collector

UNDERSTANDING

1. Explain solar energy engineering.
2. Explain the amount of solar energy available at the earth's surface with suitable equation.
3. Infer the average amount of solar energy available at the day time.
4. Explain about solar radiation measurements.
5. Explain beam radiation, diffused radiation and global radiation.
6. Summarise the reasons for variation in solar radiation reaching the earth than received at outside of the atmosphere
7. Explain pyrheliometer and pyronometer.
8. Explain in brief about sunshine recorder.
9. Explain the construction and principle of operation of a sunshine recorder.
10. Explain basic features required in an ideal pyronometer.
11. Explain with a neat sketch typical flat plate liquid collector.
12. Explain with a neat sketch solar air heater and air collector.
13. Explain parabolic focussing collector.
14. Explain non focussing collector (Flat plate collector augmented with mirrors).
15. Explain the effect of various parameters on the performance of flat plate collector.
16. Explain the effect of various parameters on the performance of concentrating collector.
17. Explain with a neat sketch solar water heater.
18. Explain with a neat sketch box type solar cooker.
19. Explain with a neat sketch working of solar dryer.
20. Explain solar greenhouse.
21. Explain briefly about the supply of adequate amount of CO_2 maintained in greenhouse.
22. Explain with a neat sketch winter green house.
23. Explain with a neat sketch summer green house.
24. Explain the principle of solar electric power generation (solar photovoltaic).
25. Explain selective coatings used in solar collectors.

APPLICATION

2. Identify the reasons for solar energy collection getting affected by tilting a flat plate collector with respect to the ground.
3. Analyse, the sun tracking helps in energy collection by a flat plate solar collector.
4. Choose the best coatings used in solar collectors for higher efficiency.
5. Select the best two applications of solar energy and explain in brief.

CO3: Identify wind energy as alternate form of energy and to know how it can be tapped

REMEMBERING

1. List the forces responsible for determining the speed and direction of global winds.
2. List the factors led to accelerated development of wind power?
3. List the factors affecting the distribution of wind energy system on the surface of the earth.

4. List the advantages and disadvantages of wind turbines.
5. List the advantages and limitations of horizontal wind turbine.
6. List the advantages and limitations of vertical wind turbine.
7. How wind energy impacts on Environment.

UNDERSTANDING

1. Outline the circulation of global winds with a help of schematic diagram.
2. Explain the mechanism for production of local winds.
3. Infer the range of wind speed is considered favourable for wind power generation.
4. Explain the basic principle of wind energy conversion.
5. Explain the forces acting on wind blades.
6. Explain the concept of lift and drag.
7. Explain the relative features of lift and drag type machines.
8. Summarise the main considerations in selecting a site for wind generators.
9. Explain with a neat sketch working of a wind energy conversion system(WECS) with main components.
10. Explain the components of wind energy conversion systems.
11. Explain with neat sketch horizontal and vertical axis wind system.
12. Explain the present prospectus of wind energy in India.

APPLICATION

1. Choose the favourable factors required in site for installing the wind turbines.
2. Choose the favourable factors for selecting a site for installing wind generators.

CO4: Explain bio gas generation and its impact on environment

REMEMBERING

1. List the usable forms of biomass, their compositions.
2. List the fuel properties.
3. List the advantages and disadvantages of biomass energy
4. List the main advantages of anaerobic digestion of biomass
5. List the factors affecting biogas generation.
6. What are the advantages and disadvantages of biogas plants.
7. List the main plants proposed for energy plantation.

UNDERSTANDING

1. Summarise in brief about the introduction of bio energy engineering.
2. Explain the process of formation of bio-mass energy.
3. Explain clearly the term biomass and biogas.
4. Explain different types of bio fuels.
5. Explain thermo chemical conversions, fermentation and anaerobic digestion.
6. Explain the composition of biogas.
7. Illustrate the various biomass conversion processes.
8. Illustrate biogas processes such digestion.
9. Explain the types of biogas plant.
10. Explain with a neat sketch floating drum type biogas plant.
11. Explain with a neat sketch fixed dome digester.
12. Compare the relative performances of a floating drum and fixed dome type biogas plants.
13. Explain with the help of block diagram ,the working of MSW incineration plant.

14. Illustrate about urban waste to energy conversion via MSW incineration method
15. Explain energy plantation, list the advantages and disadvantages
16. Explain briefly about bio diesel plants

APPLICATION

1. Identify the various biomass conversion processes.
2. Making use of a sketch explain the types of biogas plants
3. Develop the general approximate composition of MSW, discuss its heating value and discuss the problems in its development
4. Making use of MSW incineration method, how to convert urban waste in to energy.

CO5: Understand the geothermal &tidal energy, its mechanism of production & its applications

REMEMBERING

1. Define geothermal sources.
2. What is geothermal energy.
3. List the advantages and disadvantages of geothermal energy forms.
4. List the main applications of geothermal energy.
5. Choose the places of geothermal occurrence in India.
6. List the advantages and disadvantages of tidal power.
7. List the main hurdles in development of tidal energy.
8. Choose the potential sites for tidal energy in India .

UNDERSTANDING

1. Infer the origin and distribution of geothermal energy
2. Infer the nature of geothermal fields.
3. Explain the five categories geothermal sources.
4. Explain hydro thermal sources.
5. Explain with a neat sketch vapour dominated systems.
6. Explain with a neat sketch liquid dominated systems.
7. List the various applications of direct heating and Electric generation .
8. Illustrate the environmental impacts of geothermal energy .
9. Infer the present prospectus of geothermal energy in context to India.
10. Explain the sources of tidal energy, Discuss the minimum tidal range required for practical tidal plant.
11. Explain the basic principles of tidal power.
12. List the components of tidal power plants.
13. Explain with a neat sketch tidal power plant
14. Explain with a neat sketch the single basic principle of tidal power generation.
15. Explain the considerations for site selection of tidal energy.
16. Infer the prospectus of tidal power in India.

APPLICATION

1. Identify various the categories of geo-thermal fields.
2. Making use of diagram explain the Vapour dominated and Liquid dominated systems..

3. Identify the various applications of direct heating and Electric generation .
4. Identify the environmental impacts of geothermal energy.
5. Select the considerations for site to install tidal energy.

CO6: Illustrate the concepts of direct energy conversion systems & their applications.

REMEMBERING

1. List the MHD systems and classifications of MHD systems.
2. List the advantages of MHD systems.
3. What are the sources of chemical energy.
4. List the advantages and disadvantages of fuel cells.
5. What are the applications of fuel cells.

UNDERSTANDING

1. Explain the meaning of direct energy conversion systems.
2. Illustrate the principle of MHD generation.
3. Compare Open and closed cycle MHD system.
4. Explain with a neat sketch seeded inert gas system.
5. Explain the see beck effect and principle of thermo couple.
6. Explain joule effect, peltier effect and Thomson effect.
7. Explain thermo electric power generators.
8. Explain thermionic emission and work function.
9. Explain with a neat sketch basic thermo ionic generator
10. Illustrate the principle of operation of fuel cell.
11. Explain the types of fuel cell
12. Classify the fuel cells

APPLICATION

1. Identify the sources of chemical energy .
2. Making use of a Sketch, explain the seeded inert gas system

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

	Course Title: **REFRIGERATION AND AIR CONDITIONING**		
	Scheme (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15ME63F**
	Type of Course: **Lectures, Self Study & Quiz**	Credit **:04**	Core/ Elective: **Elective**
CIE: 25 Marks			SEE:100 Marks

Prerequisites: Knowledge of Applied science, Engineering Mathematics, Thermal engineering

Course Objectives:

Apply knowledge of mechanical engineering related to Refrigeration and Air conditioning equipments and expose the importance of refrigeration equipments, their control and repair and overhauling of these systems.

Course Outcomes:

On successful completion of the course, the students will be able to attain CO:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Understand the principle of refrigeration and Know the types of refrigeration	***R/U/A***	1,2	**07**
CO2	Explain the concept of various refrigeration systems and familiar with their advantages and disadvantages	***R/U/A***	1,2	**10**
CO3	Know the constructional and working of refrigeration equipments such as Compressor, condensers and Evaporators and the refrigerant flow controls	***R/U***	2	**12**
CO4	Know the different types of refrigerants and Application of refrigeration to various areas	***R/U/A***	2	**07**
CO5	Appreciate the concept of Air Conditioning and know their types	***R/U/A***	2	**08**
CO6	Familiarize the different tools used to install refrigeration system and Air Conditioner	***U***	2	**08**
		Total sessions		**52**

Legend: R: Remember U: understand A: Application An: Analysis

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
REFRIGERATION & AIR CONDITIONING	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

Unit No	Unit Name	Hour	Questions to be set for SEE/Marks			Marks weightage	weightage (%)
			R	U	A		
1	INTRODUCTION TO REFRIGERATION	07	5	5	5	15	10.34
2	REFRIGERATION CYCLES	10	5	5	20	30	20.68
3	REFRIGERANTS, SYSTEM COMPONENTS	12	5	10	20	35	24.13
4	APPLICATION OF REFRIGERATION	07	-	5	10	15	10.34
5	AIR CONDITIONING	08	5	5	10	20	17.24
6	REFRIGERATION AND AIR-CONDITIONING TOOLS	08	5	10	5	20	17.24
	Total	52	15	40	80	145	100

Legend: R; Remember, U: Understand A: Application

UNIT I: INTRODUCTION TO REFRIGERATION 07Hrs

Refrigeration-Definition-Refrigerating effect-unit of refrigeration- Coefficient of performance-Types of Refrigeration-Ice, dry ice, Steam jet, Throttling, Liquid nitrogen refrigeration-Carnot refrigeration Cycle-Air refrigeration/Bell Coleman cycle, PV& TS diagram,(without derivation)-Advantage and disadvantages in air refrigeration-Simple problems.

UNIT II: REFRIGERATION CYCLES 10Hrs

Vapour compression refrigeration cycle - Basic Components,-Flow diagram of working of Vapour compression cycle - Representation of the vapour compression cycle on P-H, T-S & P-V Diagram - Expression for Refrigerating effect, work done and power required - Types of Vapour Compression cycle - Effects of super heating and under cooling, its advantages and disadvantages - Vapour Absorption refrigeration cycle- Flow diagram of working of Vapour Absorption cycle- Comparison of Vapour absorption and vapour compression system- Simple Electrolux system for domestic units- Simple problems on simple vapour compression cycle only

UNIT III: REFRIGERATION COMPONENTS &FLOWCONTROLS 12Hrs

Compressors - types of compressors, -Reciprocating compressor-Centrifugal compressor-Hermetically sealed compressor-- condensers - Air Cooled, water cooled -evaporators – natural convection, forced convection types –Flow controls- Capillary tube- Automatic Expansion valve-Solenoid valve.

UNIT IV: REFRIGERENTS &APPLICATION OF REFRIGERATION 07Hrs

Refrigerants - properties - selection of refrigerants- Detection of refrigerants leakage- Alternate Refrigerants- testing and charging of refrigeration units –Applications of refrigeration- Cold storage - Dairy refrigeration-Icemaking industry-Transport refrigeration. Introduction to cryogenic engineering-concept.

UNIT V: AIR CONDITIONING 08 Hrs

Air conditioning –Definition- Factors affecting Air conditioning-Psychrometric processes- sensible heating and cooling-Humidifying and dehumidifying-Air conditioning types-List-Summer-Winter-use of psychometric charts- Equipments used in air conditioning cycle-air filter-dry air filter-humidifier-Types-Steam injection type humidifier-Dehumidifier-Spray type dehumidifier-Fans and blowers-Axial flow and centrifugal flow.

UNIT VI: REFRIGERATION & AIRCONDITIONING TOOLS 08Hrs

Tools used in refrigeration system- Tools used in Air conditioner installation- Installation procedure of refrigeration systems, charging ,testing, adding the oil to compressor , - Faults in refrigeration and air conditioning system- Servicing procedure of Refrigeration system

TEXT BOOKS

Sl.No.	Title of Books	Author	Publication
1.	Refrigeration and Air Conditioning	Domkundwar- Arora C P	Dhanpat rai and co.
2.	Refrigeration and Air Conditioning	Arora C P	Tata McGraw-Hill New Delhi, 3rd Edition, 2010
3	Basic Refrigetaion And air – conditioning	P N Anathanarayan	-
4.	Principles of Refrigeration	Roy.J Dossat,	Pearson Education, 4th Edition , 2006
5	Refrigeration and Air Conditioning	Jordon and Prister,	Prentice Hall of India PVT Ltd., New Delhi, 1985.
6	Refrigeration and Air Conditioning	Stoecker N.F and Jones,	TMH NewDelhi,2nd Edition 1982.

1. , LIST OF SOFTWARES/ LEARNING WEBSITES:

i. http://nptel.ac.in/courses/112105051/

ii download other power plant related videos from youtube.com for study purpose.

SPECIAL INSTRUCTIONAL STRATEGIES

UNIT NO	UNIT NAME	STARATEGIES
1	**Introduction to refrigeration**	lectures and Power point presentations/ Video/ Video movies
2	**Refrigeration cycles**	Lectures/Presentations, Showing charts,
3	**Refrigerants, system components**	Lectures/Presentations, Showing charts, Industrial visits to refrigerator repair shops
4	**Application of refrigeration**	Lectures/Presentations, Showing charts, Industrial visits to Cold storage
5	**Air conditioning**	Lectures/Presentations, Showing chart, Video/ Video movies
6	**Refrigeration and air-conditioning tools**	Lectures/Presentations, Showing charts, Industrial visits to Refrigerator/Air conditioner repair work shops

SUGGESTED LIST OF STUDENT ACTIVITYS

Note: the following activities or similar activities for assessing CIE (IA) for 5 marks (Any one)

- Each student should do any one of the following type activity or similar activity related to the course and before take up, get it approved from concerned Teacher and HOD.
- Each student should conduct different activity and no repeating should occur

1	Prepare list of various major power plants installed in Karnataka along with their total capacity.
2	Prepare charts of different high pressure boilers, gas turbine cycles, steam turbine power plant, wind turbine power plant, solar power plant, etc. on half imperial drawing sheet. Attach the same with term work.
3	Visit websites of NTPC, BHEL,, NHPC, NPCIL, GEDA, SUZLON, GE, SIEMENS, ENERCON and KPC etc and find out the technical information about their machineries or Plants.
4	Download technical specifications/ catalogues, videos or any other suitable presentations on gas turbine power plant
5	Download technical specifications/ catalogues, videos or any other suitable presentations on gas turbine power plant.
6	Visit diesel power plant available in your institute/ nearer to your institute and understand different elements, working, circuits, and specifications.

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	Three IA tests(Average of three tests will be computed)	20	Blue books	1,2,3,4,5,6
				Student activities	05	Activity sheets	1,2,3,4,5,6
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

CIE- Continuous Internal Evaluation SEE- Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks evaluated through appropriate rubrics.
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5

Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity.

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th week of sem 10-11 Am	IVSEM	**REFRIGERATION AND AIR CONDITIONING**	20
	Year: 2016-17	Course code:15ME63F	

Name of Course coordinator : Units:1,2 Co: 1,2

Note: Answer all questions

Question no	Question	MARKS	CL	CO	PO
1	Define 1 ton of refrigeration. Show how one ton refrigeration is expressed in kW. OR Or Explain refrigeration by throttling process with temperature -pressure diagram	05	U	1	2
2	List the advantages and disadvantages of vapour refrigeration over air refrigeration system.	05	R	2	2
3	An ammonia refrigerator produces 20 tones of ice at 0^0C in 24 hours. The temperature range of the system is -15^0C. The vapour leaving the compressor's dry-saturated. Assuming actual COP is 75% of theoretical, calculate the power required to run the compressor. Take latent heat of ice as 335 kJ/kg. Use the following properties of ammonia.	10	A	2	1,2

Saturation temp in ^{0}C	Enthalpy(kJ/kg)		Entropy(kJ/kg-K)	
	h_f	h_g	s_f	s_g
25	99.94	1317.95	0.3469	4.4816
-15	-54.50	1303.74	-0.2132	5.0536

MODEL QUESTION PAPER

VI- Semester Diploma Examination

Course Title: **REFRIGERATION AND AIR CONDITIONING**

Time: **3 Hours**] [Max Marks**:** **100**

Note: Answer any **SIX from Part A** and any **SEVEN from Part B**

PART-A

6x5=30 marks

1. Define the following terms:
   i. Refrigeration
   ii. Refrigerating effect
2. List the advantages and disadvantages of under cooling in the VCR system.
3. Define compressor, condenser.
4. Define refrigerant. List the types of refrigerant leak detector
5. Define following psychrometric properties
   a. WBT
   b. DBT
   c. Humidity
   d. Relative humidity
   e. Dew point temp.
6. Explain the procedure of adding the oil to compressor
7. Explain hermetically sealed compressors.
8. Explain the effect of under cooling on the COP of a vapour compression refrigeration cycle with T-S diagram
9. Build the expression for volumetric efficiency of reciprocating compressor with P-V diagram.

PART-B

7x10=70 marks

1) a. Explain refrigeration by throttling process with temperature -pressure diagram. 05

   b. Ice is formed at 0^0C from water at 20^0C. The temperature of brine solution is-10^0C reversible carnot cycle. Latent heat of ice is = 336kj/kg. find the Kg of ice formed per 1kWhr.Assume the refrigeration cycle is perfect. 05

2) Develop an expression for work done and COP of a vapour compression refrigeration cycle(dry saturated) with T-S diagram.

3) 1An ammonia refrigerator produces 20 tones of ice at 0^0C in 24 hours. The temperature range of the system is -15^0C. The vapour leaving the compressor's dry-saturated. Assuming actual COP is 75% of theoretical, calculate the power required to run the compressor. Take latent heat of ice as 335 kJ/kg. Use the following properties of ammonia.

Saturation temp	Enthalpy(kJ/kg)	Entropy(kJ/kg-K)

in ^{0}C	h_f	h_g	s_f	s_g
25	99.94	1317.95	0.3469	4.4816
-15	-54.50	1303.74	-0.2132	5.0536

10

4) Explain with sketch the natural convection evaporator(with and without baffle).

5) A. Write a note on automatic expansion valve with neat sketch. 05

B. Explain with sketch the operation of solenoid valve for variable refrigerant flow control. 05

6) a. Explain on transport refrigeration. 05

b. List any five essential properties of good refrigerants. 05

7) a. List any four different types of air filters used in air conditioning 04

b. Explain bag type dry air filter with sketch. 06

8) Explain the causes for faults in refrigeration system 10

9) Select the procedure should be adopted for replacing the evaporator(with and without valves) from the system 10

10) a. Explain with sketch the winter air conditioning system for mild and cold weather. 07

b. Classify refrigerants. 03

****

MODEL QUESTION BANK

Diploma in Mechanical Engineering
VI Semester

CO1: Understand the principle of refrigeration and know the types of refrigeration

REMEMBERING

1) Define the following terms:
   i. Refrigeration
   ii. Refrigerating effect
   iii. Ton of refrigerator
   iv. Heat pump
   v. Refrigerator
   vi. COP
2) Define 1 ton of refrigeration. Show how one ton refrigeration is expressed in kW.
3) Name five means of producing refrigeration.
4) List the advantages and disadvantages liquid nitrogen refrigeration with Specific field of application.
5) List the advantages and disadvantages Air refrigeration with specific field of application.

UNDERSTANDING

1) Explain how a refrigerant produces cooling effect?
2) Explain how the ice can be used for refrigeration? Is it possible to produce the temperature below zero degree with the help of ice?
3) Compare the direct and indirect refrigeration system with advantages and disadvantages.
4) Explain refrigeration by throttling process with temperature -pressure diagram.

APPLICATION

5) Make use of sketch explain dry ice refrigeration
6) Make use of sketch explain Steam jet refrigeration
7) Make use of sketch Explain liquid nitrogen refrigeration

8) Make use of sketch Explain Carnot refrigeration Cycle with with PV and TS diagram.

9) Make use of sketch Explain Air refrigeration/ Bell-Coleman refrigeration Cycle with with PV and TS diagram.

10) Ice is formed at 0^0C from water at 20^0C. The temperature of brine solution is-10^0C reversible carnot cycle. Latent heat of ice is = 336kj/kg. find the Kg of ice formed per 1kWhr.Assume the refrigeration cycle is perfect

11) A Carnot refrigerator extracts 400 kJ of heat per minute from a cold room which is maintained at -15^0 C and it is discharged to atmosphere which is at 30^0 C. Find an ideal kW-capacity of motor required to run the unit.

12) A reversed Carnot cycle is used to deliver 1680kJ/sec to heat the conditional space. The heat is taken from atmosphere at 100C and supplied to the conditional space at 25^0C. Find the followings: If the same quantity of heat is supplied by electric heaters, find the

a. kW required to run the system
b. consumption of electric energy in kW.

CO2: Explain the concept of various refrigeration systems and familiar with their advantages and disadvantages

REMEMBERING

1) List the advantages and disadvantages of vapour refrigeration over air refrigeration system.
2) List the advantages and disadvantages of superheating in the VCR system.
3) List the advantages and disadvantages of under cooling in the VCR system.

UNDERSTANDING

1) Compare vapour compression refrigeration system over vapour absorption refrigeration system.

APPLICATION

2) Make use of a flow diagram Explain the working principle of vapour compression refrigeration cycle.
3) Make use of P-v and T-S diagram explain the working of vapour compression refrigeration cycle.

4) Develop an expression for work done and COP of a vapour compression refrigeration cycle (dry saturated) with T-S diagram.
5) Develop an expression for work done and COP of a vapour compression refrigeration cycle (superheated) with T-S diagram.
6) Make use of T-S diagram explain the effect of under cooling on the COP of a vapour compression refrigeration cycle
7) Make use of T-S diagram Explain the effect of superheating on the COP of a vapour compression refrigeration cycle .

8) Make use of a flow diagram Explain the working principle of simple vapour absorption refrigeration cycle.
9) Make use of a flow diagram Explain the working principle of ammonia absorption refrigeration cycle.
10) Make use of a flow diagram Explain the working principle of Domestic Electrolux refrigeration cycle.
11) An ammonia refrigerator produces 20 tones of ice at 0^0C in 24 hours. The temperature range of the system is -15^0C. The vapour leaving the compressor's dry-saturated. Assuming actual COP is 75% of theoretical, calculate the power required to run the compressor. Take latent heat of ice as 335 kJ/kg. Use the following properties of ammonia.

Saturation temp in ^{0}C	Enthalpy(kJ/kg)		Entropy(kJ/kg-K)	
	h_f	**h_g**	**s_f**	**s_g**
25	99.94	1317.95	0.3469	4.4816
-15	-54.50	1303.74	-0.2132	5.0536

12) An ammonia refrigerator works between -6.7^0C and 26^0C. The vapour is dry saturated at the end of compression. Calculate
   a. Theoretical COP
   b. Power required to drive the compressor.
   If the cooling capacity of the refrigerant is 5 tons. Use the following properties of ammonia(NH_3)

Saturation temp in ^{0}C	Specific Enthalpy(kJ/kg)		Specific Entropy(kJ/kg-K)	
	Liquid h_f	Saturated vapour h_g	Liquid s_f	Saturated vapour s_g
-6.7	-29.26	1262.36	0.1087	4.7401
26.7	124.56	1291.62	0.4264	4.3263

CO3: Know the constructional and working of refrigeration equipments such as Compressor, condensers and Evaporators and the refrigerant flow controls

REMEMBER

1) Define compressor.
2) List the different types of compressors.
3) Define volumetric efficiency of a compressor.
4) Define condenser.
5) List the different types of condensers.
6) Define evaporator.
7) List the different types of evaporators.
8) List the different types of expansion devices.
9) List the advantages and disadvantages of capillary tube.

UNDERSTANDING

1) Explain hermetically sealed compressors.
2) Explain with reasons the fields of applications of each type of compressor in refrigeration system.
3) Outline the advantages and disadvantages of centrifugal compressor over reciprocating compressor.
4) Compare air cooled and water cooled condensers.
5) Explain the functions of expansion devices.

APPLICATION

1) Make use of P-V diagram Explain the cycle of working of reciprocating compressor
2) Make use of flow and P-H diagram Explain the working of centrifugal compressor
3) Make use of sketch Explain the working of air cooled condenser
4) Make use of sketch Explain the working of water cooled condenser
5) Make use of sketch Explain the natural convection evaporator(with and without baffle).
6) Make use of sketch Explain the forced convection evaporator.
7) Make use of sketch explain automatic expansion valve with neat sketch.
8) Make use of sketch Explain the operation of solenoid valve for high temperature in evaporators.

9) Make use of sketch Explain the operation of solenoid valve for low temperature in evaporators.

10) Make use of sketch Explain the operation of solenoid valve for variable refrigerant flow control.

CO4: Know the different types of refrigerants and Application of refrigeration to various areas

REMEMBER

1) Define refrigerant.
2) List the types of leak detector.

UNDERSTANDING

1) Classify refrigerants.
2) Explain the factors affecting the choice of refrigerants commonly used in refrigerating plants.
3) Outline the essential properties of good refrigerants.
4) Outline the factors are considered in selecting refrigerants in the following system and name the refrigerant in each system
    a. House hold refrigerator.
    b. Ice producing plant.
    c. Air conditioning plant.
5) Explain electronic leak detector.

APPLICATION

1) Choose the various factors to be considered to design cold storage
2) Choose the various factors to be considered to design quick freezing.

CO5: Appreciate the concept of Air Conditioning and know their types

REMEMBERING

1. Define Air conditioning.
2. List different factors affecting air conditioning.
3. Define psychrometry.
4. List and define psychrometric properties.
5. List different air conditioning equipments.
6. List different types of air filters used in air conditioning.
7. List different types of humidifiers used in air conditioning.

8. List different types of dehumidifiers used in air conditioning.
9. List different types of blowers used in air conditioning.
10. List the major difference between fans and blowers.

UNDERSTANDING

1. Explain briefly different factors affecting air conditioning.

APPLICATION

1. Make use of sketch Explain psychrometric chart
2. Make use of sketch Explain sensible heating
3. Make use of sketch Explain sensible Cooling
4. Make use of sketch Explain the summer air conditioning system for hot and dry outdoor conditions.
5. Make use of sketch Explain the summer air conditioning system for hot and humid outdoor conditions.
6. Make use of sketch Explain the winter air conditioning system for mild and cold weather.
7. Make use of sketch explain the following
    a. Cooling with dehumidification
    b. Cooling with adiabatic humidification of air
    c. Cooling with dehumidification.
8. Make use of sketch Explain Steam injection type humidifier.
9. Make use of sketch Explain Spray type dehumidifier.
10. Make use of sketch Explain Axial flow fans.
11. Make use of sketch Explain centrifugal flow fans.

CO6: Familiarize the different tools used to install refrigeration system and Air Conditioner

UNDERSTANDING

1) Explain the different instruments used for the measurement of temperature, pressure, electricity, velocity of air and flow of air(Ref. Basic Refrigeration and Air Conditioning-P N Ananthanarayanan)
2) Explain the installation procedure for refrigerating units.
3) Explain the charging of refrigerating unit with neat sketch.
4) Explain the procedure of adding the oil to compressor.
5) Explain the different tests for refrigerants leakage.

6) Explain the procedure of removing the compressor from refrigeration non sealed unit.
7) Explain the procedure of removing the compressor from refrigeration sealed unit.
8) Explain the steps to be followed before disconnecting the condenser from the refrigeration system.
9) Explain the procedure should be adopted for replacing the evaporator(with and without valves) from the system.
10) Outline the points should be remembered for the maintenance of household refrigerator
11) Explain the causes for faults in refrigeration system.

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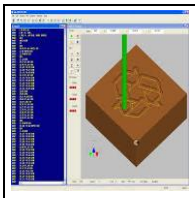	Course Title: **CNC LAB**		
	Scheme (L:T:P) : **0:2:4**	Total Contact Hours: **78**	Course Code: **15ME64P**
	Type of Course: **Tutorial and practice**	Credit **:03**	Core/ Elective: **Core(practice)**
CIE:25 Marks			SEE:50 Marks

Prerequisites: Learning concepts of Computer Integrated manufacturing

Course Objectives:

1. By undergoing this lab the students will learn to use the CNC machines efficiently for manufacturing desired products and knowledge of programming and use of CNC tooling

Course Out comes

Students *On successful completion of the course, the students will be able to attain CO:*

Course Outcome		CL	Linked experiments	Linked PO	Teaching Hrs
CO1	Appreciate the importance of CNC lathe and CNC Milling machines	***U/A***	1-10	2,3,4	**18**
CO2	Understand the codes (G-code and M-Code) used in CNC machines for programming	***U/A***	1-10	2,3,4	**15**
CO3	Develop Programming skills and crate an component for required drawing, Simulate the prepared part programme using available simulation software's. And Prepare the parts on CNC	***U/A***	1-10	2,3,4	**27**
Total sessions					**78**

Legend: U: Understand A: application

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
CNC LAB	**0**	**3**	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.
Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

LIST OF GRADED PRACTICAL EXERCISES

The practical/Graded exercises should be properly designed and implemented with an attempt to develop different types of learning out comes in affective domain and psychomotor domain, so that students are able to acquire the necessary skills. Following is the list of experiments to be carried out.

Exercise No.	Practical/Exercise	Apprx. Hrs. Required
PART A. CNC turning centre part programming *Students would:* a. Sketch each part with dimensions. b. Prepare CNC part programme using G and M codes with ISO format. C.Show various zeros and tool path on part sketch with color codes and dimensions. d. Simulate the prepared part programme using available simulation software's. e. Prepare the parts on CNC		
1	Develop a part program for step turning and simulate	06
2	Develop a part program for taper turning and simulate	06
3.	Develop a part program for circular interpolation and simulate	06
4	Develop a part program for multiple turning operation and simulate	06
5	Develop a part program for thread cutting, grooving and simulate	06
6	Develop a part program for internal drills, boring and simulate	06
PART- B. CNC machining centre part programming *Students would:* a. Sketch each part with dimensions. b. Prepare CNC part programme using G and M codes with ISO format. C. Show various zeros and tool path on part sketch with color codes and dimensions. d. Simulate the prepared part programme using available simulation software's. e. Prepare the parts on CNC		
7	Develop a part program for grooving and simulate on CNC Milling	09
8	Develop a part program for drilling (canned cycle) and simulate	09
9	Develop a part program for mirroring with subroutines and simulate	12
10	Develop a part program for rectangular and circular pocketing and simulate	12
	TOTAL	**78**

TEXT BOOKS & REFERENCE

S. No.	Title of Book	Author	Publication
1	CNC Machines.	Pabla B.S., Adithan M.	New Age International, New Delhi,2014(reprint).
2	CAD/CAM: computer aided design and manufacturing.	Groover Mikell P, Zimmered W Emory	Prentice Hall 2014.
3	Computer Numerical Control-Turning and Machining centers.	Quesada Robert	Prentice Hall 2014.
4	CAD/CAM.	Sareen Kuldeep	S.Chand 2012.
5	Introduction to NC/CNC Machines.	Vishal S.	S.K.Kataria & Sons. 2012.
6	Computer Aided Manufacturing.	Rao P N, Tiwari N K, Kundra T	Tata McGraw Hill 2014.

SUGGESTED LEARNING RESOURCES

- http://www.nptel.ac.in
- http://www.youtube.com/watch?v=M3eX2PKM1RI
- http://www.youtube.com/watch?v=EHQ4QIDqENI&list=PLBkqkLQO2nAt5
- http://www.youtube.com/watch?v=hJFLcvtiNQI
- http://www.youtube.com/watch?v=BIM1AyxfYkw .
- http://www.mtabindia.com
- http://www.swansoftcncsimulator.com

SUGGESTED LIST OF STUDENT ACTIVITES

1. Each student should submit any one of the following type activity or any other similar activity related to the course and before take up get it approved from concerned Teacher and HOD.
2. Each student should conduct different activity and no repeating should occur

1	Visit nearby industry having CNC machines. List and state important features of them with detail specifications and name of manufacturers.
2	Download free simulation software's available on website and practice for part programming
3	At least take two simple mechanical components likes step turned shaft, sleeve, muff measure the dimensions, prepare the sketch and develop part program, then simulate

Course Delivery:

The course will be delivered through specific instructional strategies detailed as below

S.N.	Unit Name	Strategies
1	Introduction.	Videos, Presentations, Demonstration.
2	CNC Turning & Machining Centers..	Videos, Presentations, Industrial Visits, Demonstration,
3	CNC part programming.	Simulation software, actual practice on CNC machines, Demonstration,

Course Assessment and Evaluation Scheme:

Method	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
DIRECT ASSESSMENT	**CIE** (Continuous Internal Evaluation)	**IA** Tests	Students	Two Tests (Average of two tests to be computed)	10	Blue books	1,2,3
				Record Writing (Average marks of each exercise to be computed)	10	Record Book	1,2,3
				Activity	05	Report	1,2,3
				TOTAL	25		
	SEE (Semester End Examination)	End Exam		End of the course	50	Answer scripts at BTE	1,2,3
INDIRECT ASSESSMENT	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3, Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3 Effectiveness of Delivery of instructions & Assessment Methods

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS MODEL

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the performed activity.

Note to IA verifier: ***The following documents to be verified by CIE verifier at the end of semester***

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Method

Scheme of Valuation for End Examination

Serial no	Description	Marks	
1	**Part A – CNC Turning** **Writing**	10	**20**
	Execution	10	
1	**Part B – CNC Milling** **Writing**	10	**25**
	Execution	15	
3	**Viva**		**5**
		TOTAL	**50**

EQUIPMENT LIST: Quantity: 01 Each

Sr. No.	Resource with brief specification
1	CNC Turning Centre (Tutor or Productive)- Minimum diameter 25 mm, Length 120 mm with ATC. (Approximate)
2	CNC Machining Centre (Tutor or Productive)- X axis travel - 225 mm, Y axis travel - 150 mm, Z axis travel - 115 mm, With ATC.(Approximate)
3	Simulation software likes: CNC Simulator Pro, Swansoft CNC, etc.
4	Latest version of CAD/CAM integration software like MASTER CAM, NX CAM

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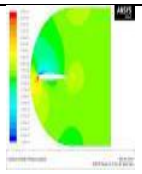


Course Title: **Computer Aided Analysis and Simulation lab**		
Scheme (L:T:P) : **0:2:4**	Total Contact Hours: **78**	Course Code: **15ME65P**
Type of Course: **Tutorial and practice**	Credit **:03**	Core/ Elective: **Core(practice)**
CIE:25 Marks		SEE:50 Marks

Prerequisites: Learning concepts of strength of materials, machine design and Computer aided engineering.

Course Objectives:

To make students understand and learn about the analysis and simulation of simple mechanical parts through software and the solving techniques of various engineering problems.

Course Out comes

Students *On successful completion of the course, the students will be able to attain CO:*

Course Outcome		CL	Linked experiments	Linked PO	Teaching Hrs
CO1	Learn ANSYS- Analysis Software/Any analysis soft ware	***U/A***	1-8	2,3,4	**09**
CO2	Use the ANSYS software/Any open source analysis soft ware for solving various problems	***U/A***	1-8	2,3,4	**50**
CO3	Have a good grip on simulations of the models any of the analysis software	***U/A***	1-8	2,3,4	**19**
Total sessions					**78**

Legend: U: Understand A: application

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
CAS LAB	**0**	**3**	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.
Method is to relate the level of PO with the number of hours devoted to the Cos which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

LIST OF GRADED PRACTICAL EXERCISES

The practical/Graded exercises should be properly designed and implemented with an attempt to develop different types of learning out comes in affective domain and psychomotor domain, so that students are able to acquire the necessary skills.

Exercise No.	Practical/Exercise	Apprx. Hrs. Required
	ANALYSIS and SIMULATION USING ANSYS	
1	Introduction to computer aided analysis and simulation	06
2	Awareness about using ANSYS	02
3.	Familiarisations of using ANSYS	02
4.	Tutorial on Finite element analysis - Introduction-Element properties-one dimensional problems-beams and frames-three dimensional problems in stress analysis	10
5	**Stress Analysis of Bars of Constant Cross Section Area** 1. Determine the nodal displacement, stress in each element and reaction forces of bar subjected to a Tensile force. 2. Determine the nodal displacement, stress in each element and reaction forces of bar subjected to a Compression force.	06
6	**Stress Analysis of Bars of Tapered Cross Section Area** 1. Determine the nodal displacement, stress in each element and reaction forces of Taper bar subjected to a external loads.	06
7	**Stress Analysis of Bars Varying In Cross Section or Stepped Bars** 1. Determine the nodal displacement, stress in each element and reaction forces of Stepped bar subjected to a external loads.	10
8	**Stress analysis of Beams** 1. Draw the shear force and bending moment diagrams for the given Cantilever beam due to applied load. 2. Draw the shear force and bending moment diagrams for the given Simply supported beam due to central point load 3. Draw the shear force and bending moment diagrams for the given Simply supported beam due to UDL 4. Draw the shear force and bending moment diagrams for the given Simply supported beam due to applied load(one point loads, and UDL) 5. Draw the shear force and bending moment diagrams for the given Simply supported beam due to Uniformly varying load(UVL) 6. Draw the shear force and bending moment diagrams for the given Simply supported beam due to applied load(Several point loads,UVL)	30
9	**Stress Analysis of a Rectangular Plate with a circular Hole** 1. Determine the stress acting on a rectangular plate with a	06

	circular hole due to the applied external load	
	TOTAL	**78**

TEXT BOOKS & REFERENCE

S. No.	Title of Book	Author	Publication
1	ANSYS free software tutorial	Free soft ware (Student version)	https://www.google.co.in/search?biw=1024&bih=667&q=ansys+software+tutorial&sa=X&ved=0ahUKEwjm5o_MndHNAhUBsI8KHbRWDhUQ1QIIXygE

SUGGESTED LEARNING RESOURCES

- http://www.nptel.ac.in
- www.**ansys**.com/Student
- https://www.google.co.in/search?biw=1024&bih=667&q=ansys+software+free+download+for+windows+7+64+bit&sa=X&ved=0ahUKEwjm5o_MndHNAhUBsI8KHbRWDhUQ1QIIXCgB
- https://www.google.co.in/search?biw=1024&bih=667&q=ansys+software+free+download+for+windows+7+32+bit&sa=X&ved=0ahUKEwjm5o_MndHNAhUBsI8KHbRWDhUQ1QIIXSgC
- https://www.google.co.in/search?biw=1024&bih=667&q=ansys+software+tutorial&sa=X&ved=0ahUKEwjm5o_MndHNAhUBsI8KHbRWDhUQ1QIIXygE
- http://www.colorado.edu/MCEN/MCEN4173/Ansys_introduction.pdf
- http://www2.warwick.ac.uk/fac/sci/eng/study/pg/students/esrhaw/introduction_to_ansys.pdf
- http://www.mece.ualberta.ca/tutorials/ansys

SUGGESTED LIST OF STUDENT ACTIVITES

1. Each student should submit any one of the following type activity or any other similar activity related to the course and before take up get it approved from concerned Teacher and HOD.
2. Each student should conduct different activity and no repeating should occur

1	Ask the students to take the simple problems in Strength of Materials, analyze the stresses by using software.
2	Ask the students to take the simple problems in Design of machine elements, analyze the stresses by using software.
3	At least take two simple mechanical components likes step turned shaft, measure the dimensions, Apply loads and analyze for stresses.
4	Study and understand the concept of theories of failure –Maximum shear stress theory, Maximum distortion energy theory (Von-Mises Theory of failure)
5	Identify the theory of failure for the brittle material and ductile materials

Course Delivery:

The course will be delivered through specific instructional strategies detailed as below

S.N.	Unit Name	Strategies
1	Introduction to Analysis software	Demonstration
2	Tutorial	Demonstration by any free software/ /Open source software
3	Problems for analysis.	Open source software

Course Assessment and Evaluation Scheme:

Method	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
DIRECT ASSESSMENT	**CIE** (Continuous Internal Evaluation)	**IA** Tests	Students	Two Tests (Average of two tests to be computed)	10	Blue books	1,2,3
				Record Writing (Average marks of each exercise to be computed)	10	Record Book	1,2,3
				Activity	05	Report	1,2,3
				TOTAL	25		
	SEE (Semester End Examination)	End Exam		End of the course	50	Answer scripts at BTE	1,2,3
INDIRECT ASSESSMENT	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3, Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3 Effectiveness

						of Delivery of instructions & Assessment Methods

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS MODEL

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the performed activity.

Note to IA verifier: ***The following documents to be verified by CIE verifier at the end of semester***

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Method

Serial no	Description	Marks	
1	**ANSYS Basic**	10	**20**
	Pre-processing	10	
2	**Solution, Post-processing**	10	**25**
3	**Result , Conclusion with analytical comparisons**	15	
4	**Viva**		**5**
		TOTAL	**50**

Scheme of Valuation for End Examination

EQUIPMENT LIST: Quantity: 01 Each

Sr. No.	Resource with brief specification
1	Computer processor 500 GB HDD 1GB Graphics accelerator 2 GB RAM System-30 Nos 17" TEF Color Monitor Intel Core i3 /i5/i7
2	Color Desk Jet Printer-1 No
3	Operating system – Windows XP, Windows 7, Windows 8
3	Software ANSYS student Version (freely available)/Any open source software http://www.ansys.com/Products/Academic/ANSYS-Student

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

	Course Title: **PROJECT WORK (Mechanical Stream)**		
	Scheme (L:T:P) : **0:2:4**	Total Contact Hours: **78**	Course Code: 15ME66P
	Type of Course: **Practice**	Credit **:03**	Core/ Elective: **Practice**
CIE- 25 Marks			SEE- 50Marks

Prerequisites: Application learned concepts form the previous semester studied courses.

Course Objectives:

1. Learn the objective of this project is to provide opportunity for the students to implement their skills acquired in the previous semesters to practical problems/problems faced by industry/development of new facilities
2. Make the students come up with innovative/ new ideas in his area of interest.
3. Identify, analyze and develop opportunities as well as to solve broadly defined mechanical Engineering problems
4. Enhance students' appreciation of the values of social responsibility, legal and ethical principles, through the analysis and discussion of relevant articles and real time projects

Course outcome

On successful completion of the course, the students will be able to:

Course Outcome		CL	Linked PO	Allotted hours
CO1	Get an idea and confidence in designing, analysing and executing the project.	Analysis/creation	1,2,3,4,8,9,10	**6hrs/Week**
CO2	Apply the knowledge of latest trends in fabrication/ manufacturing and Relate their ideas while executing the project	Analysis/creation	1,2,3,4,8,9,10	
CO3	Have complete understanding of Executing the project	Analysis/creation	1,2,3,4,8,9,10	
CO4	Prepare documents in team and enhance his written and oral communication presentations.	Analysis/creation	1,2,3,4,8,9,10	
CO5	Develop individual confidence to handle various engineering assignments and expose themselves to acquire life skills to meet societal challenges	Analysis/creation	1,2,3,4,5,8,9,10	
		TOTAL		**78 Hours**

MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

Course	Programme Outcome									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
	Basic knowledge	Discipline knowledge	Experiments a practice	Engineering Tools	Engineer and society	Environment & Sustainability	Ethics	Individual and Team work	Communication	Life long learning
PROJECT WORK	1	3	3	2	1	0	0	3	2	3

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.
Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

1. PROJECT WORK: 78 HRS

A. INTRODUCTION

The objective of the project work is to enable the students in convenient groups of minimum of 5 members on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.

B. ROAD MAP FOR THE PROJECT

1. Carry out a session or a seminar from the ISTE Student Chapter coordinator / Programme coordinator with the help of Innovation club / I I I cell for directing the students to identify project areas in the field of their interested including interdisciplinary areas.
2. Power point presentation in seminar should include detail description of project areas related to program, Project report formats, developing personnel writing skills.
3. The Students/Departments may at liberty to form the batch not less than 5 and maximum 8 and get registered with project coordinator/HOD at the end of V semester.
4. Students should take the approval from the Project committee/ Head of department for doing project.
5. After approval the batch of students will be published in department notice board along with guide in the end of 5th semester.
6. All students should finalize their Project immediately before commencement of SEE of 5th semester.
7. The types of project may include:
    - Industrial case study

- Preparation of a feasibility report
- Design and development of equipment.
- The overhauling of existing equipment
- Creation of New facilities

8. The project should be challenging but manageable within the resources and time available.
9. Students should undergo reviews for one times in 5th and one times in 6th semester during the internal assessment. Time table for IA should include project review.The guide should monitor the progress of Project work periodically and it should be finally evaluated for 25 marks at the end of 5th semester and for 25 marks at the end of 6th semester.
10. The IA marks will be evaluated based on oral presentation and assessment by the internal guide by adopting Rubrics being developed by Project committee.
11. Real time problems, Industry related problems, should be chosen and it is a Responsibilities of the project committee / Programme coordinator/ Innovation club / I.I.T. cell to choose the appropriate project and to accept the Project Proposal
12. **Identification of Topic:** The selection of topic is of crucial importance. It should be field of interest. It is advisable to choose the project can be completed on time and within the budget and resources. The topic should be clear, directional, focussed and feasible.
13. An outline of project proposal submitted & synopsis from student will initiate a dialogue between Student and Project coordinator who will then help you to work on the chosen topic and report.

C. Industrial visit

Students are required to undergo an industrial visit for period of at least 3(Three) working days, in V semester only. After completion of their visit the reports should be prepared. Each Student should write the report independently in view of his own observation in industry. All days for the visit should be accounted for clearly giving attendance particulars. The concern accompanying staff is to check student presence and access progress periodically

D.Industrial report

Students are required to submit a comprehensive report on factory visit with details of the organization where the training was undergone. The comprehensive report should focus on study of plant/ product /process/ along with intensive in-depth study on anyone of the topics such as processes, methods, tooling, plant layout and equipment, highlighting aspects of quality, productivity of the system. Any data, drawings etc should be incorporated with the consent of the Organization. The comprehensive report should be submitted for the end exam for evaluation

E. Thrust areas identified for Project work

Each student may be assigned any one of the following types of project/thesis work:

According to the local needs, the following major projects are suggested:

1. Non-conventional energy

- Low Cost Solar Water Heating System for Domestic Purpose
- Fabrication of Solar cooker
- Study of Community Biogas Plant
- Fabricate a thermally efficient wood burning stove
- Solar lamps
- Solar powered refrigerator

2. Mechatronics/Material handling area

- Motorized object lifting jack
- Key controlled- fork lifter
- Object counting machine
- Stepper motor control with selected steps for conveyor belts
- Robotic arm with gripper
- Material handling device in X,Y,Z motion control
- Robotic crane
- Robotic trolley for material handling

3. Fluid power and control area
   Pneumatic/Hydraulic jack
   Pneumatic/hydraulic crane
   Air compressed spray gun
   Pneumatic transport system
4. Automobile related area
   Regenerative braking system
   Steering controlled headlight
   Engine/motor vibration checker
   Seat belt automatic locking system
   Hydraulic braking
   Electromagnetic shock absorber
   Digital auto speed limiter
5. Motorized wheel chair
6. Design and Fabrication of various types of lab equipment's useful to polytechnic
7. Repair and overhauling of various machine tools and lab equipment's available at polytechnic
8. Critical Study of existing quality systems and inventory control at industry
9. Mechanical industry fabrication related projects
10. Automatic mopping machine to clean the floor area
11. Automatic milling machine with digital control
12. PCB fabrication
13. Any study project related to Mechanical and allied areas in industry
14. Any project related to industry based problems
15 .Any projects related to low cost automation

F. Course Assessment and Evaluation Scheme for Project work

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment met	CIE	IA	Students	At the end of 5 semester)	25	**1.** Project Synopsis. **2.** Plan & Schedule **3.** Industrial visit report	CO1, CO2, CO3,CO4,CO5
				At the end of 6 semester)	25	**1.** Project Report. **2.** Presentation hand outs	CO1, CO2, CO3,CO4,CO5
	SEE	End Exam		End of the course	50	CO1, CO2, CO3,CO4,CO5 Project report project model/Study report	
Indirect Assessment	Student Feedback on course		Students	Middle of the course	Feedback forms		CO1Delivery of course
	End of Course Survey			End of the course	Questionnaires		CO1 to CO5 Effectiveness of Delivery of instructions & Assessment Methods

***CIE** – Continuous Internal Evaluation ***SEE** – Semester End Examination

G. Project report

The Project Report should consist of following items.

1. Introduction
2. Review of Literature
3. Study Area
4. Methodology/Design/fabrication/Tests
5. Result and Discussion
6. Conclusion and scope for future study
7. References.

1. Project reports should be typed neatly in Times New Roman letters with font size 14 for titles and 12 for text on both sides of the paper with 1.5 line spacing on a A4 size paper (210 x 297 mm). The margins should be: Left - 1.5", Right - 1", Top and Bottom - 0.75".

2. The total number of reports (**Soft bound**) to be prepared are

- One copy to the department /library

- One copy to the concerned guide(s)
- One copy to the candidate.

3. Before taking the final printout, the approval of the concerned guide(s) is mandatory and suggested corrections, if any, must be incorporated.

4. Every copy of the report must contain

- Inner title page (White)
- Outer title page with a plastic cover
- Candidate declaration and Certificate in the format enclosed both from the institution and the organization where the project is carried out.
- An abstract (synopsis) not exceeding 100 words, indicating salient features of the work.

5. The organization of the report should be as follows

1. Inner title page 2. Abstract or Synopsis 3. Acknowledgments 4. Table of Contents 5. List of table & figures (optional)	Usually numbered in roman

Chapters(to be numbered in Arabic) containing Introduction-, which usually specifies the scope of work and its importance and relation to previous workand the present developments, Main body of the report divided appropriately into chapters, sections and subsections.

The chapters, sections and subsections may be numbered in the decimal form for e.g. Chapter 2, sections as 2.1, 2.2 etc., and subsections as 2.2.3, 2.5.1 etc.

The **chapter must be left or right justified** (**font size** 16). Followed by the **title of chapter centered** (**font size 18**), **section/subsection numbers along with their headings must be left justified** with **section number and its heading in font size** 16 and **subsection and its heading in font size** 14. The **body or the text** of the report should have font size 12.

The figures and tables must be numbered chapter wise

The last chapter should contain the summary of the work carried, contributions if any, their utility along with the scope for further work.

Reference or Bibliography: The references should be **numbered serially** in the order of their occurrence in the text and their numbers should be indicated within square brackets for e.g. [3]. The section on references should list them in serial order in the following format.

1. For textbooks – Dr.Paramar S, Welding process and technology, Khanna publishers, New Delhi, 2 Edition, 2003.
2. For papers – Y.Javadi and I.sattari, Welding distortion in pipes, Journal of pressure vessels and piping, Vol 85, Aug 2008, pp 337-343

Only SI units are to be used in the report. Important equations must be numbered in decimal form for e.g.

- **V = IZ** ..... **(3.2)**

All equation numbers should be right justified.

Separator sheets, used if any, between chapters, should be of thin paper

I.CIE ASSESSMENT FOR FINAL REVIEW(VI semester)	
1. Relevance of the subject in the present context	05 mark
2. Literature Review	05 mark
3. Plan and schedule of Fabrication of the model /Data collection/repair and Overhauling work /creation	10mark
4. Results & Discussion	05 mark
	25 Marks

J.SEE ASSESSMENT:	
1. Relevance of the subject in the present context	05 mark
2. Literature Review	05 mark
3. Fabrication of the model/Data collection/repair and Overhauling work/creation	25 mark
4. Results & Discussion	05 mark
5. Presentation	10 mark
TOTAL	**50 mark**

MODEL OF RUBRICS FOR ASSESSING REVIEWS OF PROJECT FOR CIE

Student name	Reg no	Dimension	Scale					Students Score				
			Unsatisfactory	Developing	satisfactory	Good	Exemplary	1	2	3	4	5
		Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic					
		Fulfil team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles					
		Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.					
		Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount					
		Grand Average/Total										

APPENDIX 1 (Cover page)

(A typical Specimen of Cover Page)<Font Style Times New Roman – Bold>

TITLE OF PROJECT REPORT

<Font Size 18><1.5 line spacing>

A PROJECT REPORT

<Font Size 14>

Submitted by

<Font Size 14><Italic>

NAME OF THE CANDIDATE(S)

<Font Size 16>

in partial fulfilment for the award of the diploma

of

<Font Size 14><1.5 line spacing><Italic>

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME

<Font Size 16>

IN

DEPARTMENT OF MECHANICAL ENGINEERING

<Font Size 14>

LOGO

NAME OF THE COLLEGE

<Font Size 14>

DEPARTMENT OF TECHNICAL EDUCATION

BENGALURU-560001

<Font Size 16><1.5 line spacing>

Year of submission: (MONTH & YEAR)

<Font Size 14>

APPENDIX 2 (Title page)

(A typical Specimen of Title Page) <Font Style Times New Roman – Bold>

A Project Report
on

<TITLE OF THE PROJECT WORK>

Submitted for partial fulfilment of the requirements for the award of the
of

DIPLOMA IN CIVIL ENGINEERING

BY
BATCH
<Mr. / Ms. Name of the Student (Roll No.)>
<Mr. / Ms. Name of the Student (Roll No.)>
<Mr. / Ms. Name of the Student (Roll No.)>
<Mr. / Ms. Name of the Student (Roll No.)>
<Mr. / Ms. Name of the Student (Roll No.)>

Under the guidance of

<Name of the Staff>
Lecturer
Department of ME
GPT, Place--------

Department of Mechanical Engineering
<<NAME OF INSTITUTE>>
<<ADDRESS OF INSTITUTE>>

APPENDIX 3 (Certificate)

(A typical specimen of Bonafide Certificate)
<Font Style Times New Roman>

DEPARTMENT OF TECHNICAL EDUCATION BENGALURU-560001

<Font Style Times New Roman – size -18>

BONAFIDE CERTIFICATE

<Font Style Times New Roman – size -16>

<Font Style Times New Roman – size -14>

Certified that this project report **"…….TITLE OF THE PROJECT……..."**is the bonafide work of "**……..NAME OF THE CANDIDATE(S)……"**who carried out the project work under my supervision.

<<Signature of the Head of the Department>>

SIGNATURE

<<Name>>

HEAD OF THE DEPARTMENT

<<Department>>

<<Full address of the Dept & College >>

<<Signature of the Project coordinator>>

SIGNATURE

<<Name>>

PROJECT CORDINATOR

<<Academic Designation>>

Department of Mechanical Engineering

<<Full address of the Dept & College >>

Examiners 1.....<<Signature, Name, Designation& Address>>.....

Examiners 2.....<<Signature, Name, Designation& Address>>.....

APPENDIX 4 (Candidate declaration)

CANDIDATE'S DECLARATION

I, ---------- a student of Diploma in ---------- Department bearing Reg No----------of ---------- hereby declare that I own full responsibility for the information, results and conclusions provided in this project work titled **"**----------"submitted to **StateBoard of Technical Examinations, Government of Karnataka** for the award of Diploma in ----------.

To the best of my knowledge, this project work has not been submitted in part or full elsewhere in any other institution/organization for the award of any certificate/diploma/degree. I have completely taken care in acknowledging the contribution of others in this academic work. I further declare that in case of any violation of intellectual property rights and particulars declared, found at any stage, I, as the candidate will be solely responsible for the same.

Date:

Place: **Signature of candidate**

Name: ----------

Reg No----------

--

APPENDIX 5 (Certificate issued by guide)

DEPARTMENT OF TECHNICAL EDUCATION

NAME OF THE INSTITUTION

Address with pin code

Department of ……..

CERTIFICATE

Certified that this project report entitled ----------

---- ----------”which is being submitted by Mr./Ms. ……..……., Reg. No…..……, a bonafide student of ……in partial fulfilment for the award of **Diploma in ----------Engineering** during the year …….... is record of students own work carried out under my/our guidance.It is certified that all corrections/suggestions indicated for internal Assessment have been incorporated in the Report and one copy of it being deposited in the polytechnic library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said diploma.

It is further understood that by this certificate the undersigned do not endorse or approve any statement made, opinion expressed or conclusion drawn there in but approve the project only for the purpose for which it is submitted.

Guide(s)

Name and signature

Examiner 1

2 **Head of Department**

Dept. of ----------

APPENDIX 6

Format of Synopsis

1. Title of the Project
2. Objectives of the study
3. Rationale for the study
4. Statement of the Problem
5. Detailed Methodology to be used for carrying out the study
6. The expected contribution from the study (to perform any laboratory experiments)
7. List of activities to be carried out to complete the project (with the help of a bar chart showing the time schedule)
8. Places/labs/equipment and tools required and planning of arrangements
9. Problems envisaged in carrying out the project, if any.
10. Brief description of project in 100 words

APPENDIX-7 (PROJECT-TIME LINE)

SL.No	TASK	Responsibility	END OF V SEMESTER					VI SEMESTER													
	WEAKS		11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Industrial visit	Students/Faculty																			
1	Seminar regarding Project work	Project Com/HOD																			
2	Batch formation &Guide allocation	HOD																			
3	Identification of project	Students/Guide																			
4	Project synopsis Submission	Students																			
5	Finalisation of Project	Students/Guide																			
6	Literature survey	Students/Guide																			
7	Identification of facility to do PW	Guide																			
8	Study/Fabrication/design of model	Students/Guide																			
9	Results discussion/performance testing	Students																			

10	Review of Project work by guide	Students																			
11	Project report submission	Students/Guide																			

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

	Course Title: **INPLANT TRAINING (Mechanical Stream)**		
	Scheme: **4hrs/week**	Total Contact Hours: **52**	Course Code:15ME67P
	Type of Course: **Periodical Exposure and working in industrial environment**	Credit **:02**	Core/ Elective: **Core(practice)**
CEE:25 Marks			

Prerequisites: Enthusiasm to Explore New things by participating in individual tasks available in outside industrial learning environment and acquires skills from participating in such activities.

Course Objectives:

An In plant training is a learning opportunity for students. Students should therefore receive feedback on their performance so that they can grow professionally. Overall professional development of diploma mechanical engineers is the need of the day for enabling them to sustain in competitive global environment..

COURSE OUTCOME

On successful completion of the course, the students will be able to:

Course Outcome		CL	Linked PO	Allotted hours
CO1	Exposure to the industrial environment and Recognize the requirement of the industry and cope up with the industrial scenario	Application/Analysis/Innovative	2,3,4,10	**4 hrs/weak**
CO2	Identify career paths taking into account their individual strengths and aptitude and Prepare a report about the work experience in industry	Application/Analysis/Innovative	2,8,9,10	
CO3	Communicate effectively through technical presentation.	Application/Analysis/Innovative	2,9	
CO4	Enhancing the employability skills and start-up skills to increase his ability to engage in, life-long learning,	Application/Analysis/Innovative	2,3,4,10	
CO5	Develop individual confidence to handle various engineering assignments and expose themselves to acquire life skills to meet societal challenges	Application/Analysis/Innovative	2,3,5,8,10	
		TOTAL		**52 Hours**

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
INPLANT TRAINING	**0**	**3**	**2**	**2**	**1**	**0**	**0**	**2**	**2**	**3**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

1. In plant training: 52 HRS

A. Introduction

1. In-plant training means a course of training in any industry or establishment undergone by the student of final year diploma in Mechanical engineering in pursuance of memorandum of understanding between industry and department of the concerned institute or department can make necessary arrangements in the local vicinity industries to expose their students for industry learning environment.
2. Industry means any industry or business in which any trade, occupation or subject field in engineering or technology may be specified as a designated trade. Establishment includes any place where any industry is carried on.

3. The period of in-plant training will be the period of one semester term for the subject. The student can sent to the industry for one day in a weak or for fixed term as the case may be .The period of training and other modalities will be decided by the respective department head in consultation with local industry authorities.

B. The Industries where in plant training can undergone

1. The Guide allotted by the department head have liberty to select nearby organization/industry of local vicinity with prior approval of principal of the institute. Structured training to be arranged by guide and report of the same shall be submitted by the individual student, to full fill their term work.
2. The mechanical engineering diploma students can take in plant training in any one of the following industries.
    a. Public sector enterprises
    b. State government undertaking
    c. Public limited companies
    d. Private limited companies
    e. Individual ownership organisations
    f. Karnataka State Road Transport depot work shops
    g. Karnataka State Road Transport Regional body building work shops
    h. Karnataka Milk Federations Milk Processing and chilling units
    i. Agro based food processing units
    j. Agro based industries
    k. Farm machinery equipments manufacturing units

l. Local leading automobile dealer workshops
m. Stone crushers / Cement mix plant/ service stations of JCBs and other earthmoving equipment
n. Local heavy fabrication units
o. Power looms
p. Local Garment industries
q. Local cement industries
r. Paper mills
s. Sugar factories
t. Textile industry / Textile machinery manufacturing / garment manufacturing /embroidery / textile printing and dying units.
u. Any ancillary units
v. All MSMEs, recognised by state government
w. Karnataka power transmission master unit sub stations
x. The power generation units
y. Local diesel power plants
z. Automobile manufacturing / press component / auto component manufacturing units in local polytechnic vicinity

C. Obligation on students

1. To learn his/her subject field in Engineering or Technology conscientiously and diligently at his place of training.

2. To carry out all orders of his Employer and the Superior in the establishment.

3. To abide by the Rules and Regulations of the Industry/Establishment in all matters of conduct and discipline.
4. The student shall maintain a report of his work during the period of his in-plant training in a proforma Annexure-1
5. They are required to complete their in-plant training in a given period.
6. During this period, they shall be familiar with the understanding of the shop process and activities.
7. The students can be asked to solve the mini-shop problem, which will make them think and try out short experiments as an improvement in the process, tools and equipment.

D. Monitoring of In-Plant Training

1. The department ,Head will make the batches in group of students, The faculty will made in charge of supervising and monitoring the activity of the group
2. The faculty and Industry supervisor will work out a suitable arrangement to review the progress of the work from time to time. The department Head should monitor the progress of in-plant training in association with industry authority.
3. Every student undergoing in-plant training in the respective branch of Engineering in any Establishment shall be treated as a trainee. The provision of any law with respect to labour will not apply to such a trainee
4. It shall not be obligatory on the part of the Employer / Industry to offer any stipend and other welfare amenities available, if any, to the students undergoing in-plant training. However, if the industry desirous to do so, at will be a privilege for the students

E.CIE - Scheme of Evaluation

1. CIE

SL No	Particulars	Marks
1	Involvement in implant training	05
2	Assessment of the term work	10
3	Seminar performance	05
4	Viva	05
	TOTAL	**25**

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	CIE	25	Report (Annexure1)	1,2,3,4,5
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3, Effectiveness of Delivery of instructions & Assessment Methods

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Student activities report for25 marks
2. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods.

ANNEXURE1

(To be issued in the company's Letterhead-Optional)

INPLANT TRAINING EVALUATION FORM

FOR THE STUDENTS OF FINAL YEAR DIPLOMA IN _____

Date:

1. Name of the Student and Reg. No.----------
2. Father's Name : .----------
3. Branch . ----------
4. In plant training Offered : From---------- To----------

A. Evaluation of the Student may be done with the following letter grades. The grade point for the letter grades is given below.

Grades	A	B	C	D	E (low)
Points	5	4	3	2	1

B. Assessment parameters

Sl NO	Parameters	Grades awarded
1	Knowledge Acquired During Internship	
2	Ability to use Techniques and Methods Appropriate for Assignments	
3	Ability to Display the Technical Skills required	
4	Ability to Organize, Classify and Deliver the job	
5	Perseverance to Complete the job	
6	Takes Initiative and Works with Minimal Supervision	
7	Attendance and Punctuality	
8	Ability to Establish Positive Relationships with the Managers and Peers	
9	Personal Conduct and Behaviour	
10	Ability to Cope Up with the Stressful Situations	

C. Department (s) / Section (s) where the in plant trainee was accommodated:

SL NO	**Department (s)/Section(S)**	**Type of Work**	**Period**	
			From	**To**

5. Areas where student excels:

6. Areas where student needs to improve:

7. Areas where student gained new skills, insights, values, confidence, etc.:

8. Did student demonstrate continued progress throughout the internship term?:

9. Was student's academic preparation sufficient for this internship?

10. Additional comments or suggestions for the student?

11	Overall Evaluation of the in plant trainee Performance	Grade Awarded

Name / Signature of Officer In-charge (Training) :

Authorized Signatory :

ANNEXURE 2

REPORT ON INPLANT TRAINING

FORMAT FOR PREPARATION OF TRAINING REPORT

(Four Weeks/Six Weeks/ Six Months)

ARRANGEMENT OF CONTENTS:

The sequence in which the training report material should be arranged and bound as follows:

1. Cover Page
2. Inner Title Page (Same as cover page)
3. Certificate by Company/Industry/Institute
4. Acknowledgement
5. About Company/industry/institute
6. Table of Contents
7. List of Tables
8. List of Figures
9. Abbreviations and Nomenclature(If any)
10. Chapters
11. References
12. Data Sheet(If any)
13. Appendices (If any)

The tables and figures shall be introduced in the appropriate places.

TYPING INSTRUCTIONS:

1. The In plant training report must be submitted in Two Copies (one for department and 2nd for library) duly signed by the HOD. Students should also submit the soft copy on CD in pdf format in the library.
2. The length of the training report may be about 40 to 50 page.
3. The training report shall be computer typed (English- British, Font -Times Roman, Size-12 point) and printed on A4 size paper.
4. The training report shall be hard bound with cover page in Maroon color. The name of the students, degree, duration of training period, institute name shall be printed in **Bold Black** letters on the cover page

5. The training report shall be typed with 1.5 line spacing with a margin 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and at bottom. Every page in the report must be numbered. The page numbering, starting from acknowledgements and till the beginning of the introductory chapter, should be printed in small Roman numbers, i.e, i, ii, iii, iv..... The page number of the first page of each chapter should not be printed (but must be accounted for). All page numbers from the second page of each chapter should be printed using Arabic numerals, i.e. 2,3,4,5... All printed page numbers should be located at the bottom centre of the page.
6. In the training report, the title page [Refer sample sheet (inner title pager)] should be given first and printed in black letters.
7. **The table of contents** should list all headings and sub-headings. The title page and certificates will not find a place among the items listed in the Table of Contents. One and a half line spacing should be adopted for typing the matter under this head.
8. **The list of tables** should use exactly the same captions as they appear above the tables in the text. One and a half spacing should be adopted for typing the matter under this head.
9. **The list of figures** should use exactly the same captions as they appear below the figures in the text. One and a half spacing should be adopted for typing the matter under this head.
10. The list of symbols, abbreviation & nomenclature should be typed with one and a half line spacing. Standard symbols, abbreviation etc should be used.
11. Training report should consist of following chapters.
    a. Chapter 1- Introduction
    b. Chapter 2- Details of department/Areas where the student undergone training

       (It will be divided into several chapters and each chapter should be numbered separately. A chapter may be further divided into several divisions and sub-divisions depending on the content
    c. Chapter 3- PO/Skills attained by training.
    d. Chapter 4- Conclusion by the student

APPENDIX-3 (INPLANT-TRAINING-TIME LINE)

SL.No	TASK	Responsibility	END OF V SEMESTER				Vacation in between V SEM-VI SEM /During the term VI SEMESTER (Not less than 2 weeks continuously)/ During-VI SEMESTER (Every Saturday in a week)														
	WEAKS /DAYS	HOD	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Seminar regarding In plant training																				
2	Batch formation &Guide allocation	HOD																			
3	Identification of Factory	Guide																			
4	Permission form Factory authorities	Students																			
5	Schedules of In plant training	Students/Guide																			
6	INPLANT TRAINING	Students/Guide																			
7	Review of Training by guide	Students																			
8	Report submission	Students/Guide																			

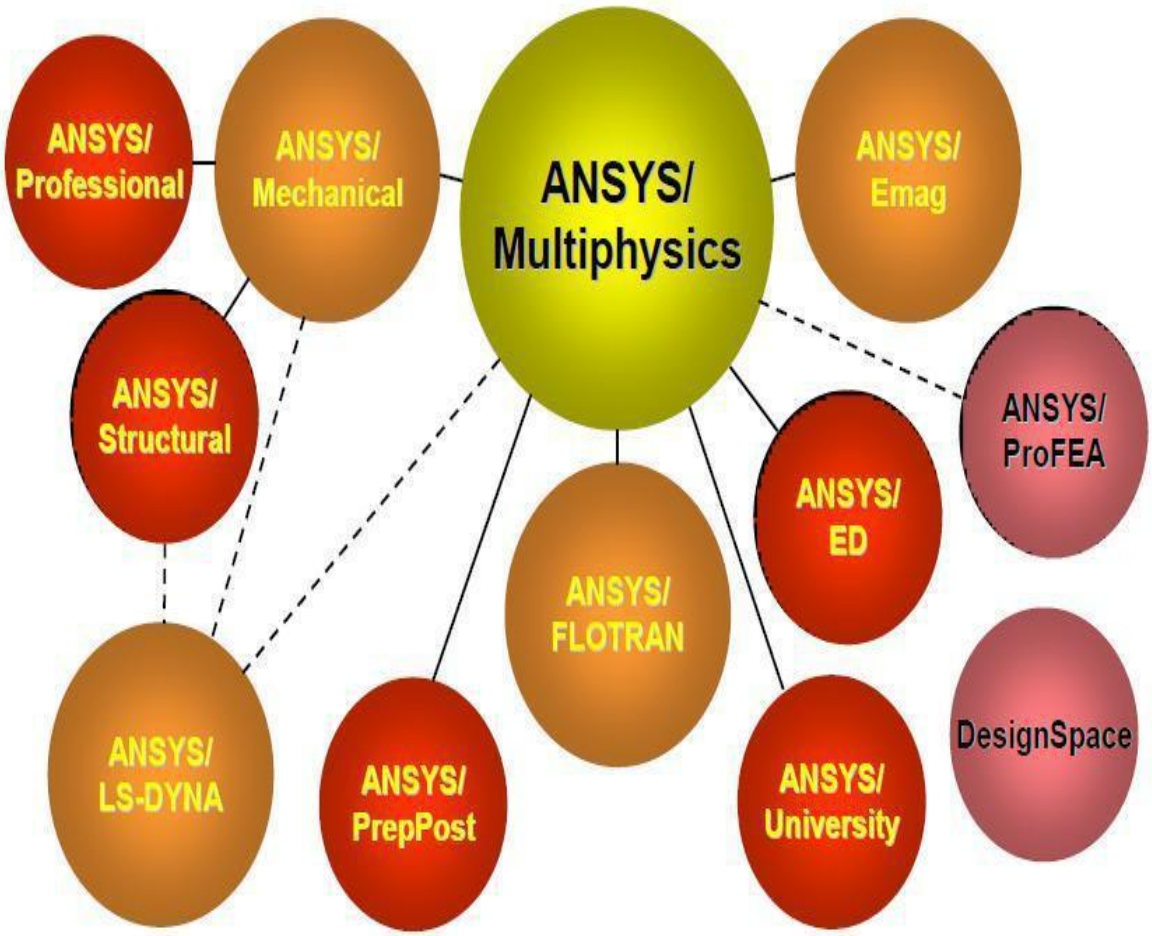
MODEL LABORATORY MANUAL

COMPUTER AIDED ANALYSIS AND SIMULATION LABORATORY

ACADEMIC YEAR 2017-18

Introduction to ANSYS

- ANSYS is a complete FEA software package used by engineers worldwide in virtually all fields of engineering:
  - Structural
  - Thermal
  - Fluid, including CFD (Computational Fluid Dynamics)
  - Electrical / Electrostatics
  - Electromagnetics
- A partial list of industries in which ANSYS is used:
  - Aerospace
  - Automotive
  - Bio-medical
  - Bridges & Buildings
- ANSYS/Multiphysics is the flagship ANSYS product which includes all capabilities in all engineering disciplines.



- There are three main component products derived from ANSYS/Multiphysics:
  - ANSYS/Mechanical - structural & thermal capabilities
  - ANSYS/Emag - electromagnetics
  - ANSYS/FLOTRAN - CFD capabilities
- Other product lines:
  - ANSYS/LS-DYNA - for highly nonlinear structural problems
  - Design Space - an easy-to-use design and analysis tool meant for quick analysis within the CAD environment
  - ANSYS/ProFEA - for ANSYS analysis & design optimization within Pro/ENGINEER

- **Structural analysis:** is used to determine deformations, strains, stresses, and reaction forces.
  - Static analysis
    - Used for static loading conditions.
    - Nonlinear behavior such as large deflections, large strain, contact, plasticity, hyper elasticity, and creep can be simulated
  - Dynamic analysis
    - Includes mass and damping effects.
    - Modal analysis calculates natural frequencies and mode shapes.
    - Harmonic analysis determines a structure‘s response to sinusoidal loads of known amplitude and frequency.
    - Transient Dynamic analysis determines a structure‘s response to time-varying loadsand can include nonlinear behavior.
  - Other structural capabilities
    - Spectrum analysis
    - Random vibrations
    - Eigen value buckling
    - Substructuring, submodeling
  - Explicit Dynamics with ANSYS/LS-DYNA
    - Intended for very large deformation simulations where inertia forces are dominant.
    - Used to simulate impact, crushing, rapid forming, etc.

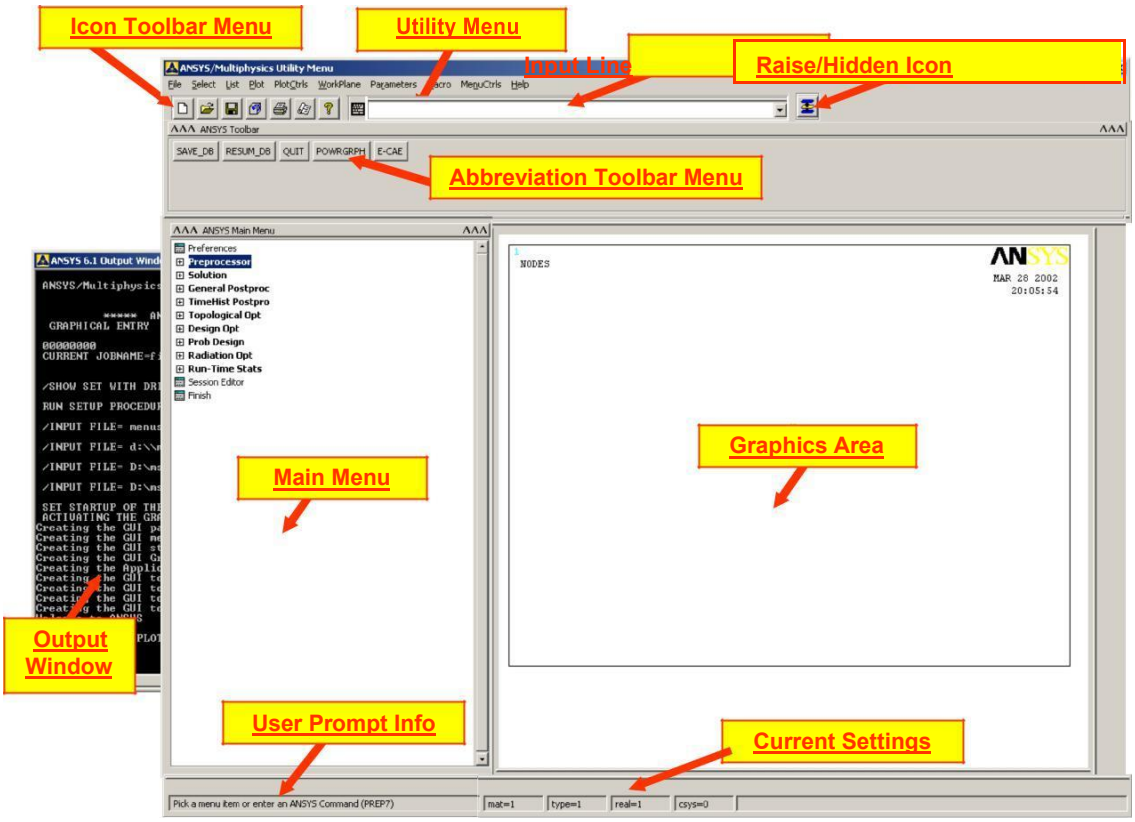
- **Thermal analysis**: is used to determine the temperature distribution in an object. Other quantities of interest include amount of heat lost or gained, thermal gradients, and thermal flux. All three primary heat transfer modes can be simulated: conduction, convection, radiation.
  - Steady-State
    - Time-dependent effects are ignored.
  - Transient
    - To determine temperatures, etc. as a function of time.
    - Allows phase change (melting or freezing) to be simulated.

- Electromagnetic analysis is used to calculate magnetic fields in electromagnetic devices.
- Static and low-frequency electro magnetic
  - To simulate devices operating with DC power sources, low-frequency AC, or low- frequency transient signals.

❖ **Computational Fluid Dynamics (CFD)**

- To determine the flow distributions and temperatures in a fluid.
- ANSYS/FLOTRAN can simulate laminar and turbulent flow, compressible andincompressible flow, and multiple species.
- Applications: aerospace, electronic packaging, automotive design
- Typical quantities of interest are velocities, pressures, temperatures, and film coefficients.

The GUI Layout



Utility Menu

Contains functions which are available throughout the ANSYS session, such as file controls, selecting, graphics controls, parameters, and exiting.

Toolbar Menu

Contains push buttons for executing commonly used ANSYS commands and functions. Customized buttons can be created.

Graphics Area

Displays graphics created in ANSYS or imported into ANSYS.

Input Line Displays program prompt messages and a text field for typing commands. All previously typed commands appear for easy reference and access.

Main Menu

Contains the primary ANSYS functions, organized by processors (preprocessor, solution, general postprocessor, etc.)

Output

Displays text output from the program. It is usually positioned behind the other windows and can be raised to the front when necessary.

Resume:

This is opening a previously saved database. It is important to know that if you simply resume a database, it doesn‘t change the job name. For example: You start ANSYS with a job name of ―file‖. Then you resume my model.db, do some work, then save. That save is done to file.db! Avoid this issue by always resuming using the icon on the toolbar. If you open mymodel.db using this method, it resumes the model and automatically changes the job name to my model.

Plotting:

Contrary to the name, this has nothing to do with sending an image to a plotter or printer. Plotting in ANSYS refers to drawing something in the graphics window. Generally you plot one type of entity (lines, elements, etc.) to the screen at a time. If you want to plot more than one kind of entity use, ―Plot → Multiplot‖, which by default will plot everything in your model at once.

Plot Controls:

This refers to how you want your ―plot‖ to look on the screen (shaded, wire frame, entity numbers on or off, etc). Other plot control functions include sending an image to a graphics file or printer.

Creating Geometry:

Geometry in ANSYS is created from
―Main Menu → Preprocessor → Modeling → Create‖ and has the following terminology,

KEYPOINTS: These are points, locations in 3D space.

LINES: This includes straight lines, curves, circles, spline curves, etc. Lines are typically defined using existing key points.

AREAS: This is a surface. When you create an area, it‘s associated lines and key points are automatically created to border it.

VOLUMES: This is a solid. When you create a volume, it‘s associated areas, lines and key points are automatically created.

SOLID MODEL: In most packages this would refer to the volumes only, but in ANSYS this refers to your geometry. Any geometry. A line is considered a ―solid model‖.

You can‘t delete a child entity without deleting its parent, in other words you can‘t delete a line if it‘s part of an area, can‘t delete a key point if it‘s the end point of a line, etc.

Boolean Operations:

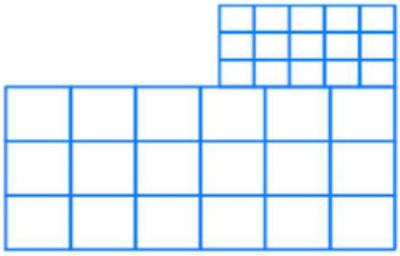
Top Down style modeling can be a very convenient way to work. Instead of first creating key points, then lines from those key points, then areas from the lines and so on (bottom up modeling), start with volumes of basic shapes and use Boolean operations to add them, subtract them, divide them etc. Even if you are creating a shell model, for example a box, you could create the box as a volume (a single command) and then delete the volume keeping the existing areas, lines and key points.

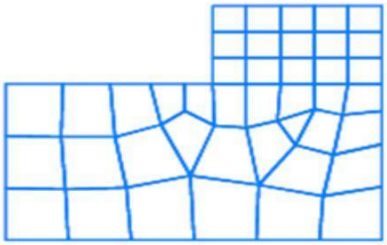
These kinds of operations are found under ―Main Menu → Preprocessor → Modeling → Operate → Booleans‖ with some common ones being:

Add: Take two entities that overlap (or are at least touching) and make them one.

Subtract: Subtract one entity from another. To make a hole in a plate, create the plate (area of volume) then create a circular area or cylinder and subtract it from the plate.

Glue: Take two entities that are touching and make them contiguous or congruent so that when meshed they will share common nodes. For example, using default mesh parameters,

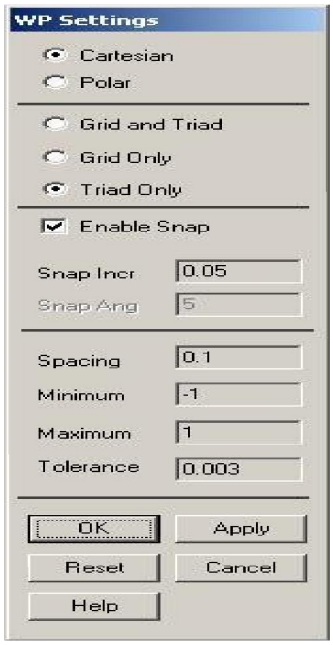




Meshing without gluing areas. **Meshing after gluing areas.**

Note: In case of Meshing after gluing areas. The coincident nodes on the common line between the two areas will be automatically merged. You don't have to manually equivalence them like in some other codes.

The Working Plane:



All geometry is created with respect to the working plane, which by default is aligned with the global Cartesian coordinate system. The ―Working Plane‖ is actually the XY plane of the working coordinate system. The working coordinate system ID is coordinate system 4 in ANSYS. Global Cartesian is ID 0, Global Cylindrical is ID 1, and Global Spherical is ID 2.

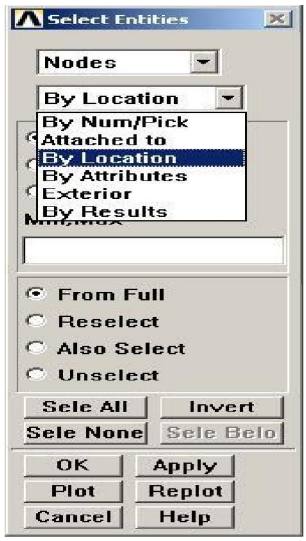
Working Plane Hints:

Turn on the working plane so you can see it with, ―Utility Menu → Work Plane → Display Working Plane‖.
Change the way the working plane looks or adjust the snap settings under ―Utility Menu → Work Plane → WP Settings…‖.
Move the working plane around using ―Utility Menu → Work Plane → Offset WP to…‖.
Align the working plane with various parts of the model using ―Utility Menu → Work Plane → Align WP with…‖.
If you select more than one node or keypoint to offset the working plane to, it will go to the average location of the selected entities. VERY handy!
Use the working plane to slice and dice your model. For example to cut an area in pieces use ―Main Menu → Modeling → Operate → Booleans → Divide → Area by WrkPlane‖. Do this for lines and volumes as well.

Select Logic:

Selecting is an important and fundamental concept in ANSYS. Selected entities are your active entities. All operations (including Solving) are performed on the selected set. In many operations you select items ―on the fly‖; ANSYS prompts for what volumes to mesh for example, you pick them with the mouse, and ANSYS does the meshing.

However there are many times when you need to select things in more sophisticated ways. Also, in an ANSYS input file or batch file you can't select things with the mouse!



Examples where this would be useful:

- You have many different areas at Z = 0 you want to constrain. You could select them all one by one when applying the constraint, or select ―By Location‖ beforehand, then say ―Pick All‖ in the picking dialog.
- You have a structure with many fastener holes that you want to constrain. Again, you could select them all one by one when applying the constraint, or select lines ―By Length/Radius‖, type in the radius of the holes to select all of them in one shot, then ―Pick All‖ in the picking dialog when applying the constraint.

After working with the selected set,

―Utility Menu → Select → Everything‖ to make the whole model active again.

Select Entities Dialog Box Terminology:

From Full: Select from the entire set of entities in the model.

Reselect: Select a subset from the currently selected entities.

Also Select: Select in addition to (from the whole model) the set you have currently selected.

Unselect: Remove items from the selection set.

Select All: This is not the same as ―Utility Menu → Select → Everything‖. This selects all of whatever entity you have specified at the top of the dialog.

Invert: Reverses the selected and unselected entities (just the entities specified at the top of the dialog).

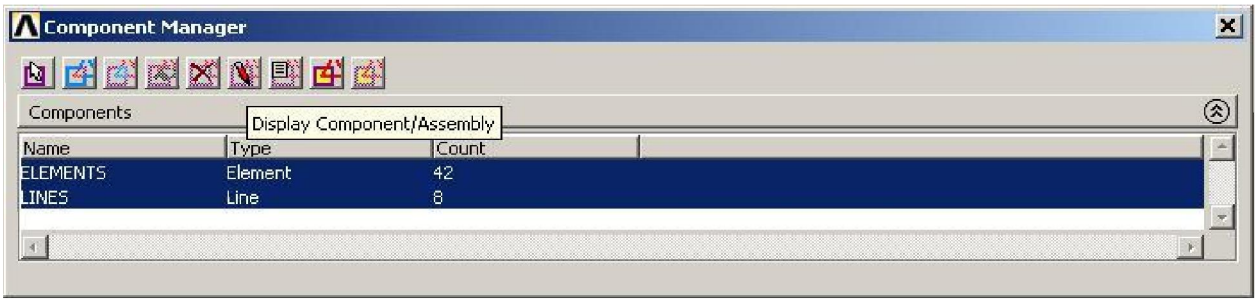
OK: This does the select operation (or brings up a picker dialog so that you can pick with the mouse) and then dismisses the dialog.

Apply: This does the operation but keeps the dialog box. Typically use this so the dialog stays active.

Replot: Replots whatever is active in the graphics window.

Plot: Plots only the entity specified at the top of the dialog.

Organizing Your Model Using Components:

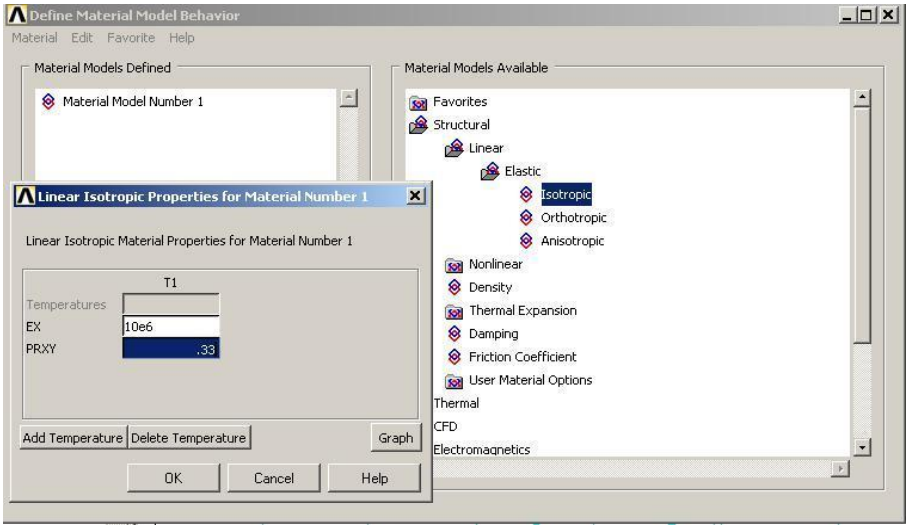


If you select a group of entities and think that you might want to use that selection set again, create a component out of it. Components are groups of entities but hold only one kind of entity at a time. Components can themselves be grouped into Assemblies, so this is how you group different types of entities together. Use ―Utility Menu → Select → Comp/Assembly → Create

Component…‖ to create a component. The new Component Manager in Release 8.0 makes it very easy to manage and manipulate groups and select/plot what you want to see to the screen. This is found under ―Utility Menu → Select → Component Manager‖

Creating a Material:

Create the material properties for your model in ―Main Menu → Preprocessor → Material Props → Material Models‖. This gives you this dialog box where all materials can be created,

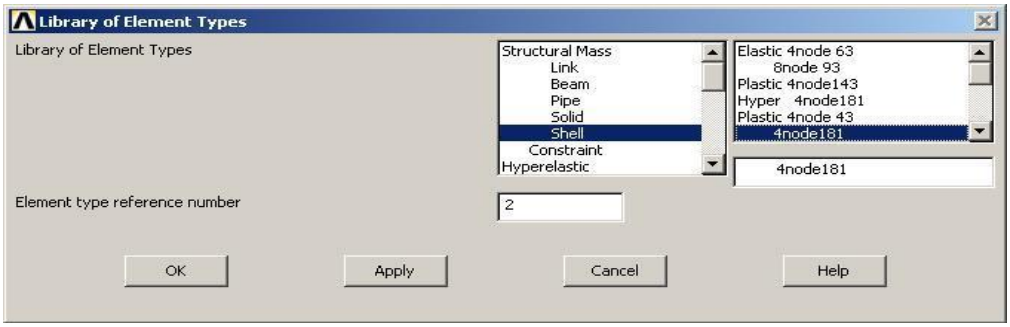


Double click on items in the right hand pane of this window to get to the type of material model you want to create. All properties can be temperature dependant. Click OK to create the material and it will appear in the left hand pane. Create as many different materials as you need for your analysis.

Selecting an Element Type:

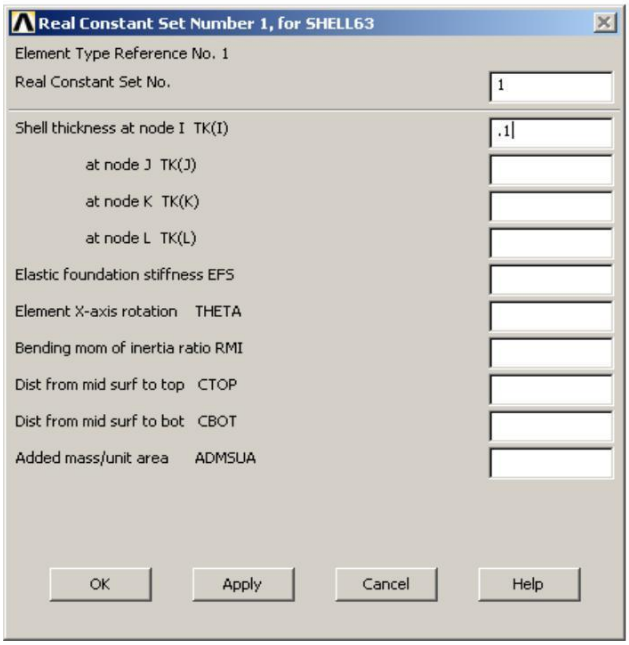
ANSYS has a large library of element types. Why so many? Elements are organized into groups of similar characteristics. These group names make up the first part of the element name (BEAM, SOLID, SHELL, etc). The second part of the element name is a number that is more or less (but not exactly) chronological. As elements have been created over the past 30 years the element numbers have simply been incremented. The earliest and simplest elements have the lowest numbers (LINK1, BEAM3, etc), the more recently developed ones have higher numbers. The ―18x‖ series of elements (SHELL181, SOLID187, etc) are the newest and most modern in the ANSYS element library.

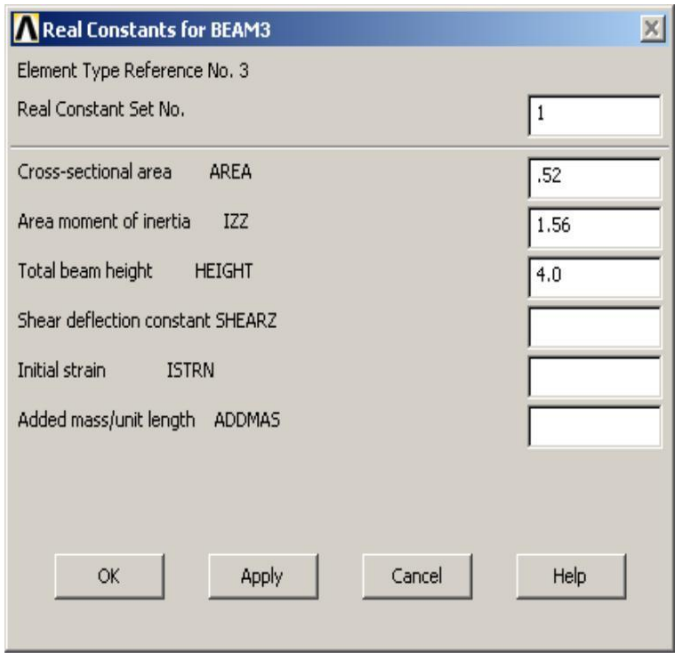
Tell ANSYS what elements you are going to use in your model using ―Main Menu → Element Type → Add/Edit/Delete‖



Later, when meshing or creating elements manually you will need to tell ANSYS what type of elements you want to create.

Creating Properties A solid element (brick or tet) knows its thickness, length, volume, etc by virtue of its geometry, since it is defined in 3D space. Shell, beam and link (truss) elements do not know this information since they are a geometric idealization or engineering abstraction. Properties in ANSYS are called Real Constants. Define real constants using ―Main Menu → Real Constants → Add/Edit/Delete‖.





Creating the Finite Elements Model - Meshing:

If you are just starting out in FEA, it is important to realize that your geometry (called the solid model in ANSYS) is not your finite element model. In the finite element method we take an arbitrarily complex domain, impossible to describe fully with a classical equation, and break it down into small pieces that we can describe with an equation. These small pieces are called finite elements. We essentially sum up the response of all these little pieces into the response of our entire structure The solver works with the elements. The geometry we create is simply a vehicle used to tell ANSYS where we want our nodes and elements to go. While you can create nodes and elements one by one in a manual fashion (called direct generation in ANSYS) most people mesh geometry because it is much another very good reason we mesh geometry is that we assign materials and properties to that geometry.

Then any element created on or in that geometric entity gets those attributes. If we don‘t like the mesh we can clear it and re-mesh, without having to re-assign the attributes.

Steps for Creating the Finite Elements:

- Assign Attributes to Geometry (materials, real constants, etc).
- Specify Mesh Controls on the Geometry (element sizes you wa
- Mesh.

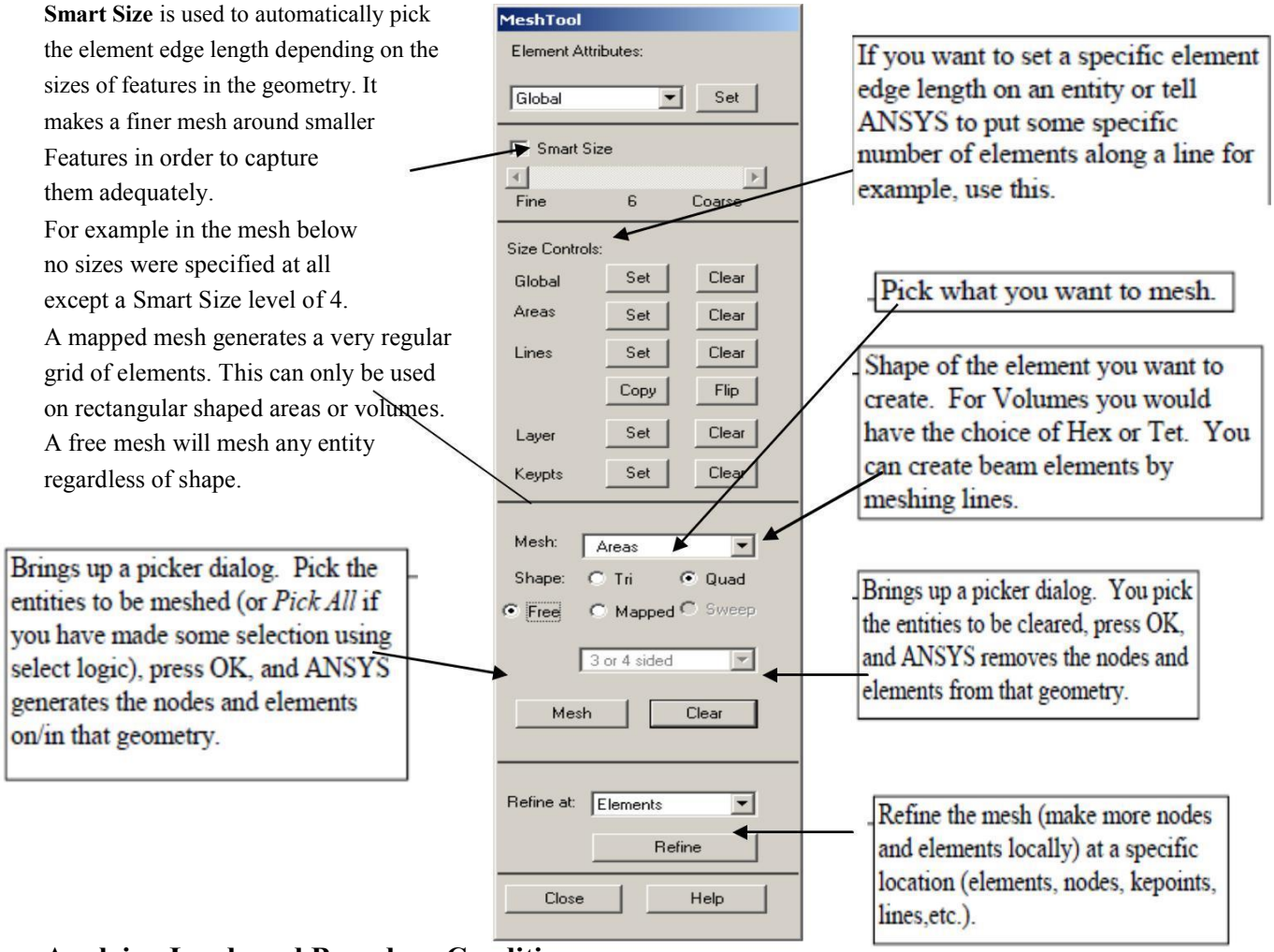
Most of the meshing operations can be done within the MeshTool, so that will be examined in some detail now. Start it from ―Main Menu → Preprocessor → Meshing → MeshTool‖.

Smart Size is used to automatically pick the element edge length depending on the sizes of features in the geometry. It makes a finer mesh around smaller Features in order to capture them adequately.

For example in the mesh below no sizes were specified at all except a Smart Size level of 4.

A mapped mesh generates a very regular grid of elements. This can only be used on rectangular shaped areas or volumes.

A free mesh will mesh any entity regardless of shape.



Applying Loads and Boundary Conditions:

Loads and boundary condition can be applied in both the Preprocessor (—Main Menu → Preprocessor → Loads → Define Loads → Apply‖), and the Solution processor (—Main Menu → Solution → Define Loads → Apply‖).

1. Select the kind of constraint you want to apply.
2. Select the geometric entity where you want it applied.
3. Enter the value and direction for it.

There is no —modify‖ command for loads and B.C.‘s. If you make a mistake simply apply it again with a new value (the old one will be replaced if it‘s on the same entity), or delete it and reapply it.

Loads: Forces, pressures, moments, heat flows, heat fluxes, etc.

Constraints: Fixities, enforced displacements, symmetry and anti-symmetry conditions, temperatures, convections, etc.

Although you can apply loads and boundary conditions to nodes or elements, it‘s generally better to apply all B.C.‘s to your geometry. When the solve command is issued, they will be automatically transferred to the underlying nodes and elements. If B.C.‘s are put on the geometry, you can re-mesh that geometry without having to reapply them

Solving:

Solution is the term given to the actual simultaneous equation solving of the mathematical model. The details of how this is done internally is beyond the scope of this guideline but is addressed in a separate ―ANSYS Tips‖ white paper. For the moment, it is sufficient to say that the basic equation of the finite element method that we are solving is, [K]{u}={F}

where [K] is the assembled stiffness matrix of the structure, {u} is the vector of displacements at each node, and {F} is the applied load vector.

This is analogous to a simple spring and is the essence of small deflection theory.

To submit your model to ANSYS for solving, go to **"Main Menu → Solution → Solve → Current LS". LS** stands for load step. A load step is a loading ―condition‖.

This is a single set of defined loads and boundary conditions (And their associated solution results. More on this in the next section). Within an interactive session the first solve you do is load step 1, the next solution is load step 2, etc.

If you leave the solution processor after solving to do post-processing for example, the load step counter gets set back to one. You can also define and solve multiple load steps all at once.

There are several solvers in ANSYS that differ in the way that the system of equations is solved for the unknown displacements. The two main solvers are the sparse solver and the PCG solver.

If the choice of solvers is left to ―program chosen‖ then generally ANSYS will use the sparse solver. The PCG (preconditioned conjugate gradient) solver works well for models using all solid elements. From a practical perspective one thing to consider is that the sparse solver doesn't require a lot of RAM but swaps out to the disk a lot. Disk I/O is very slow. If you have a solid model and lots of RAM the PCG solver could be significantly faster since the solution runs mostly in core memory

Postprocessing:

The General Postprocessor is used to look at the results over the whole model at one point in time. This is the final objective of everything we have discussed so far; finding the stresses, deflections, temperature distributions, pressures, etc. These results can then be compared to some criteria to make an objective evaluation of the performance of your design.

The solution results will be stored in the results file as result ―sets‖. For a linear static analysis like we are talking about, the correlation between Load Step numbers and Results Set numbers will be one to one as shown below. Only one set of results can be stored in the database at a time, so when you want to look at a particular set, you have to read it in from the results file. Reading it in clears the previous results set from active memory.

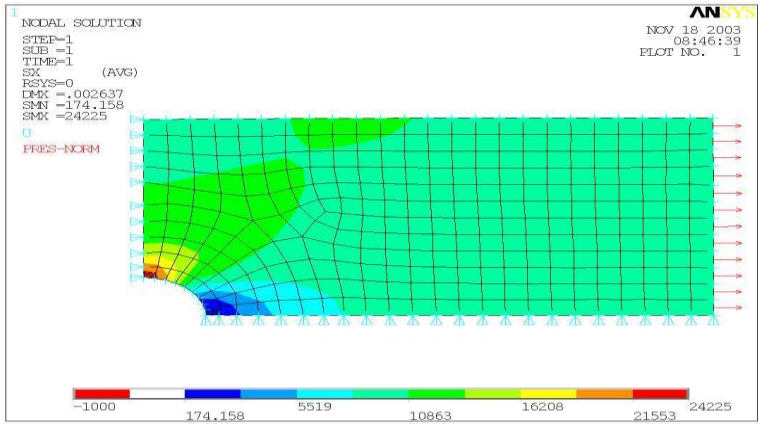
SET,LIST Command

File

***** INDEX OF DATA SETS ON RESULTS FILE *****

SET	TIME/FREQ	LOAD STEP	SUBSTEP	CUMULATIVE
1	1.0000	1	1	1
2	2.0000	2	1	2
3	3.0000	3	1	3
4	4.0000	4	1	4
5	5.0000	5	1	5
6	6.0000	6	1	6
7	7.0000	7	1	7
8	8.0000	8	1	8
9	9.0000	9	1	9
10	10.000	10	1	10
11	11.000	11	1	11
12	12.000	12	1	12

To read in a results set from the results file (not needed if you have run only a single load step) use ―Main Menu → General Postprocessor → Read Results → First Set, or By Pick‖. Most results are displayed as a contour plot as shown below. To generate a plot of stresses use ―Main Menu → General Postproc → Plot Results → Contour Plot → Nodal Solution‖, then pick the stresses you want to see



There are many, many other ways to look at your results data including:

- Listing them to a file.
- Querying with the mouse to find a result at a particular node.
- Graphing results along a path.
- Combining different load cases.
- Summing forces at a point.
- Extracting data and storing it an APDL array that you can do further operations.

Animate any result on the deformed shape with ―Utility Menu → Plot Ctrls → Animate‖. This is very helpful for understanding if your model is behaving in a reasonable way.

Experiment No: 1 **Date:**

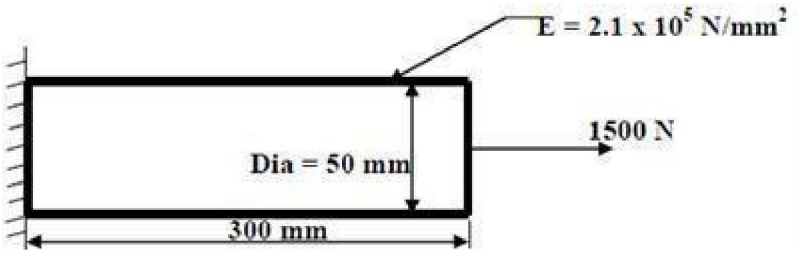
Stress Analysis of Bars of Constant Cross Section Area

AIM:

To perform displacement and stress analysis for the given bar using Ansys simulation and analytical expressions.

Problem Description:

A steel rod subjected to tension is modeled by one bar element, as shown in figure. Determine the nodal displacements and the axial stress in each Element and reaction forces. E=2.1x 10^5 N/ mm^2, 0.3 (Poisson's Ratio).



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –Link –3D finit stn 180 –ok – close.

Real constants –Add –ok –Real constant set no –1 –c/s area –22/7*50**2/4 –ok.

Material Properties –Material Models –Structural –Linear –Elastic –Isotropic –EX – 2.1e5 –ok –close.

Modeling –Create –Nodes –In Active CS –Apply (first node is Created) –x, y, z location in CS –300, 0, 0 –ok (second node is Created).

Modeling –Create –Elements –Auto numbered –Thru Nodes –pick 1 & 2 –ok (elements are Created through nodes).

Step 4: Solution

Define loads –Apply –Structural –Displacement –on Nodes- pick node 1 –Apply – DOFs to be constrained –All DOF –ok.

Define loads –Apply –Structural –Force/Moment –on Nodes - pick node 2 –Apply –

direction of For/Mom –FX –Force/Moment value –1500 (+ve value) – ok. **Solve** –Current LS –ok (Solution is done is displayed) –close**.**

Step 5: General Post Processor

Element table –Define table –Add –_Results–By data Sequence item‘num–LS–LS1 –ok.

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –LS1 – Elem table item at node J –LS1 –ok (Line Stress diagram will be displayed).

List Results –Elem table Data –Items to be listed –LS1 –ok. (Stress will be displayed with the element numbers)

List Results –Reaction Solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

List Results –Nodal Solution –DOF solution –Displacement Vector Sum –ok. (Nodal solution will be displayed with the node numbers).

List Results –Nodal loads –items to be listed –All items –ok (Nodal loads will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed shape –def+ undeformed-ok

PlotCtrls – Animate – Deformed results – DOF solution – Displacement Vector sum – ok.

Comparison between theoretical and Ansys values:

Particulars	**Ansys**		**Theoretical**	
	Node 1	**Node 2**	**Node 1**	**Node2**
Deformation				
Stress				
Reaction				

Results:

The analysis of the bar was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increasing number of nodes and elements to match the theoretical or analytical results.

Conclusions: Ansys simulation and the software results are near to theoretical or analytical results.

Experiment No: 2 **Date:**

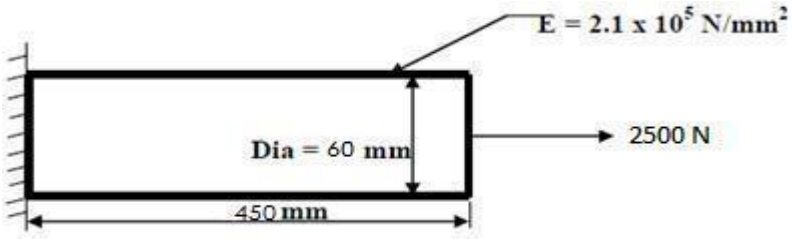
Stress Analysis of Bars of Constant Cross Section Area

AIM:

To perform displacement and stress analysis for the given bar using Ansys simulation and analytical expressions.

Problem Description:

A steel rod subjected to tension is modeled by one bar element, as shown in figure. Determine the nodal displacements and the axial stress in each Element and reaction forces. E=2.1x 10^5 N/ mm^2,0.3 (Poisson's Ratio).



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –Link –3D finit stn 180 –ok – close.

Real Constants –Add –ok –Real constant set no –1 –c/s area –22/7*60**2/4 –ok.

Material Properties –Material Models –Structural –Linear –Elastic –Isotropic –EX – 2.1e5 –PRXY –0.3 –ok –close.

Modeling –Create –Nodes –In Active CS –Apply (first node is Created) –x, y, z location in CS –450, 0, 0 –ok (second node is Created).

Modeling –Create –Elements –Auto numbered –Thru Nodes –pick 1 & 2 –ok (elements are Created through nodes).

Step 4: Solution

Define loads –Apply –Structural –Displacement –on Nodes- pick node 1 –Apply – DOFs to be constrained –All DOF –ok.

Define loads –Apply –Structural –Force/Moment –on Nodes- pick node 2 –Apply – direction of For/Mom –FX –Force/Moment value –2500 (+ve value) –ok.

Solve –Current LS –ok (Solution is done is displayed) –close**.**

Step 5: General Post Processor

Element table –Define table –Add –_Results–BydataSequence item‘num–LS–LS1-ok.

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –LS1 – Elem table item at node J –LS1 –ok (Line Stress diagram will be displayed).

List Results –Elem table Data –Items to be listed –LS1 –ok. (Stress will be displayed with the element numbers)

List Results –Reaction Solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

List Results –Nodal Solution –DOF solution –Displacement Vector Sum –ok. (Nodal solution will be displayed with the node numbers).

List Results –Nodal loads –items to be listed –All items –ok (Nodal loads will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed shape –def+undeformed-ok

PlotCtrls – Animate – Deformed results – DOF solution – Displacement Vector sum – ok.

Comparison between theoretical and Ansys values:

Particulars	**Ansys**		**Theoretical**	
	Node 1	**Node 2**	**Node 1**	**Node2**
Deformation				
Stress				
Reaction				

Results:

The analysis of the bar was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increasing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results.

Experiment No: 3 **Date:**

Stress Analysis of Bars of Constant Cross Section Area

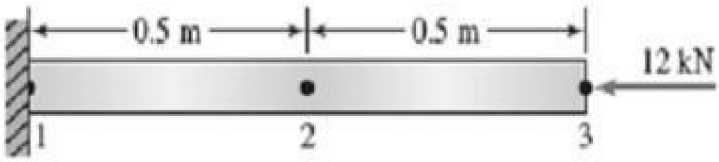
AIM:

To perform displacement and stress analysis for the given bar using Ansys simulation and analytical expressions.

Problem Description:

A steel rod subjected to compression is modeled by two bar elements, as shown in figure. Determine the nodal displacements and the axial stress in each Element. E=207 GPa,

A = 500 mm^2



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –Link –3D finit stn 180 –ok – close.

Real constants –Add –ok –Real constant set no –1 –c/s area –500 –ok.

Material Properties –Material models –Structural –Linear –Elastic –Isotropic –EX – 207e3 –ok –close.

Modeling –Create –Nodes –In Active CS –Apply (first node is Created) –x, y, z location in CS –500, 0, 0 –Apply (second node is Created) - x, y, z location in CS – 1000, 0, 0 (third node is Created).

Modeling –Create –Elements –Auto numbered –Thru Nodes –pick 1 & 2 –Apply - pick 2 & 3 (elements are Created through nodes).

Step 4: Solution

Define loads –Apply –Structural –Displacement –on Nodes- pick node 1 –Apply – DOFs to be constrained –All DOF –ok.

Define loads –Apply –Structural –Force/Moment –on Nodes- pick node 3 –Apply – direction of For/Mom –FX –Force/Moment value –- 12000 (-ve value) –ok.

Solve –Current LS –ok (Solution is done is displayed) –close**.**

Step 5: General Post Processor

Element table –Define table –Add –_Results–BydataSequence item‘num–LS–LS1–ok.

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –LS1 – Elem table item at node J –LS1 –ok (Line Stress diagram will be displayed).

List Results –Reaction Solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

List Results –Nodal Solution –DOF solution –Displacement Vector Sum –ok. (Nodal solution will be displayed with the node numbers).

List Results –Nodal loads –items to be listed –All items –ok (Nodal loads will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed shape –def+undeformed-ok.

Comparison between theoretical and Ansys values:

Particulars	**Ansys**			**Theoretical**		
	Node 1	**Node 2**	**Node 3**	**Node 1**	**Node2**	**Node 3**
Deformation						
Stress						
Reaction						

Results:

The analysis of the bar was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increaing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results.

Experiment No: 4 **Date:**

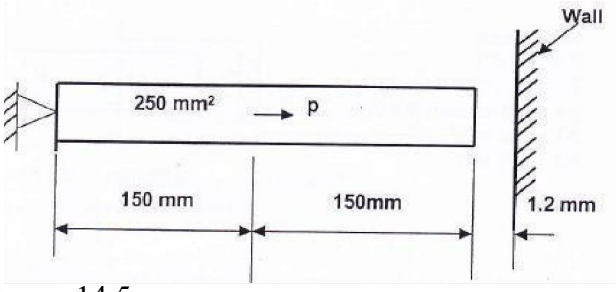
AIM:

To perform displacement and stress analysis for the given bar using Ansys simulation and analytical expressions.

Problem Description:

A load of P = 60 x 10^3 N is applied as shown. Determine the following, a) Nodal Displacement, b) Stress in each member, c) Reaction Forces.

Given Data: E=20 x10^3 N/mm^2.0.3 (Poisson'sRatio)



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –Link –3D finit stn 180 –ok – close.

Real Constants –Add –ok –Real constant set no –1 –c/s area –250 –ok.

Material Properties –Material Models –Structural –Linear –Elastic –Isotropic –EX – 20e3 –ok –close.

Modeling –Create –Nodes –In Active CS –Apply (first node is Created) –x, y, z location in CS –150, 0, 0 –Apply (second node is Created) - x, y, z location in CS –300, 0, 0 (third node is Created).

Modeling –Create –Elements –Auto numbered –Thru Nodes –pick 1 & 2 –Apply - pick 2 & 3 (elements are Created through nodes).

Step 4: Solution

Define loads –Apply –Structural –Displacement –on Nodes- pick node 1 –Apply – DOFs to be constrained –All DOF –ok.

Define loads –Apply –Structural –Force/Moment –on Nodes- pick node 3 –Apply – DOFs to be constrained –UX –VALUE - Displacement Value –1.2 - ok.

Define loads –Apply –Structural –Force/Moment –on Nodes- pick node 2 –Apply – direction of For/Mom –FX –Force/Moment value –60e3 (+ve value) –ok.

Solve –Current LS –ok (Solution is done is displayed) –close**.**

Step 5: General Post Processor

Element table –Define table –Add –_Results–BydataSequence item‘num–LS–LS1 –ok.

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –LS1 – Elem table item at node J –LS1 –ok (Line Stress diagram will be displayed).

List Results –Reaction Solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

List Results –Nodal Solution –DOF solution –Displacement Vector Sum –ok. (Nodal solution will be displayed with the node numbers).

List Results –Nodal loads –items to be listed –All items –ok (Nodal loads will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed shape –def+undeformed-ok.

Comparison between theoretical and Ansys values:

Particulars	Ansys			Theoretical		
	Node1	Node2	Node3	Node1	Node2	Node3
Deformation						
Stress						
Reaction						

Results:

The analysis of the bar was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increasing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results.

Experiment No: 6 **Date:**

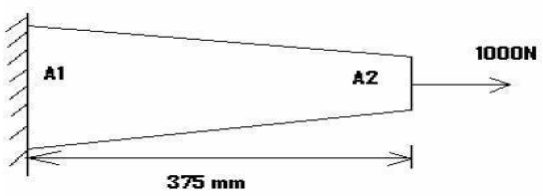
Stress Analysis of Bars of Tapered Cross Section Area

AIM:

To perform displacement and stress analysis for the given Taper bar using Ansys simulation and analytical expressions.

Problem Description:

For the tapered bar shown in the figure determine the displacement, stress and reaction in the bar. Given $A1 = 1000\ mm^2$ and $A2 = 500\ mm^2$, $E = 2x10^5\ N/mm^2$

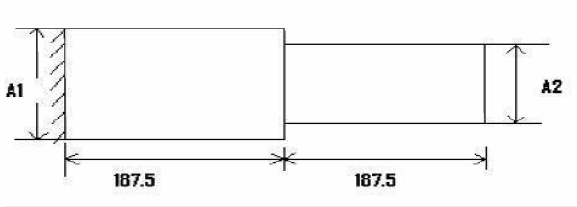


The Tapered bar is modified into 2 elements as shown below with modified area of cross section $(1000+500)/2 = 750\ mm^2$

Areas of modified two elements:

$A`1 = (1000+750)/2 = 875\ mm^2$

$A`2 = (750+500)/2 = 625\ mm^2$



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –Link –3D finit stn 180 –ok – close.

Real constants –Add –ok –Real constant set no –1 –c/s area –875 –ok. Add –ok – Real constant set no –2 –c/s area 625– ok.

Material Properties –Material models –Structural –Linear –Elastic –Isotropic –EX – 2e5 –ok –close.

Modeling –Create –Nodes –In Active CS –Apply (first node is Created) –x, y, z location in CS –187.5, 0, 0 –Apply (second node is Created) - x, y, z location in CS – 375, 0, 0

(third node is Created).

Modeling –Create –Elements –Auto numbered –Thru Nodes –pick 1 & 2 –Apply - pick 2 & 3 (elements are Created through nodes).

Step 4: Solution

Define loads –Apply –Structural –Displacement –on Nodes- pick node 1 –Apply – DOFs to be constrained –All DOF –ok.

Define loads –Apply –Structural –Force/Moment –on Nodes- pick node 2 –Apply – direction of For/Mom –FX –Force/Moment value –1000 (+ve value) –ok.

Solve –Current LS –ok (Solution is done is displayed) –close**.**

Step 5: General Post Processor

Element table –Define table –Add –_Results–BydataSequence item‘num–LS–LS1–ok.

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –LS1 – Elem table item at node J –LS1 –ok (Line Stress diagram will be displayed).

List Results –Reaction Solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

List Results –Nodal Solution –DOF solution –Displacement Vector Sum –ok. (Nodal solution will be displayed with the node numbers).

List Results –Nodal loads –items to be listed –All items –ok (Nodal loads will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed shape –def+undeformed-ok.

Comparison between theoretical and Ansys values:

Particulars	Ansys			Theoretical		
	Node1	Node2	Node3	Node1	Node2	Node3
Deformation						
Stress						
Reaction						

Results:

The analysis of the bar was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increaing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results.

Experiment No: 7 **Date:**

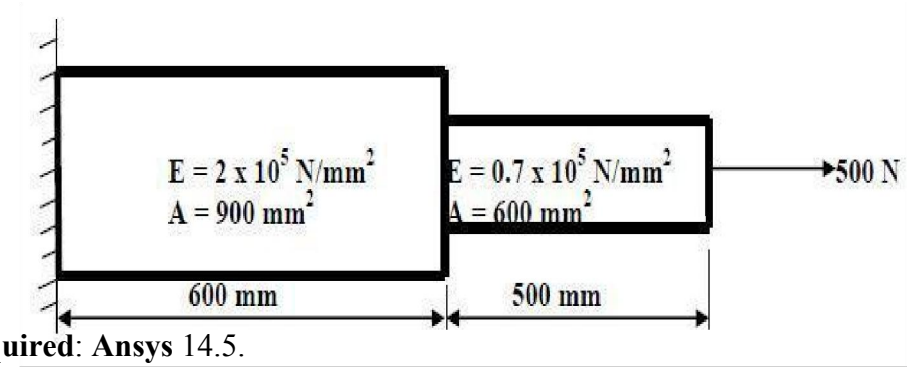
Stress Analysis of Bars Varying In Cross Section or Stepped Bars

AIM:

To perform displacement and stress analysis for the given stepped bar using Ansys simulation and analytical expressions.

Problem Description:

Consider the stepped bar shown in figure below. Determine the nodal displacement stress in each element, reaction forces.



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –Link –3D finit stn 180 –ok –close.

Real constants –Add –ok –Real constant set no –1 –c/s area –900 –ok. Add –ok – Real constant set no –2 –c/s area 600–ok.

Material Properties –Material Models –Structural –Linear –Elastic –Isotropic –EX – 2e5 –ok,

Material –New model –Define material ID –2 –ok –Structural –Linear –Elastic – Isotropic –EX –0.7e5 –ok –close.

Modeling –Create –Nodes –In Active CS –Apply (first node is Created) –x, y, z location in CS –600, 0, 0 –Apply (second node is Created) - x, y, z location in CS – 1100, 0, 0 (third node is Created).

Modeling –Create –Elements –Auto numbered –Thru Nodes –pick 1 & 2 –Apply - pick 2 & 3 (elements are Created through nodes).

Step 4: Solution

Define loads –Apply –Structural –Displacement –on Nodes- pick node 1 –Apply – DOFs to be constrained –All DOF –ok.

Define loads –Apply –Structural –Force/Moment –on Nodes - pick node 3 –Apply – direction of For/Mom –FX –Force/Moment value –500 (+ve value) –ok.

Solve –Current LS –ok (Solution is done is displayed) –close**.**

Step 5: General Post Processor

Element table –Define table –Add –_Results–BydataSequence item‘num–LS–LS1–ok.

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –LS1 – Elem table item at node J –LS1 –ok (Line Stress diagram will be displayed).

List Results –Reaction Solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

List Results –Nodal Solution –DOF solution –Displacement Vector Sum –ok. (Nodal solution will be displayed with the node numbers).

List Results –Nodal loads –items to be listed –All items –ok (Nodal loads will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed shape –def+undeformed-ok.

Comparison between theoretical and Ansys values:

Particulars	Ansys			Theoretical		
	Node1	Node2	Node3	Node1	Node2	Node3
Deformation						
Stress						
Reaction						

Results:

The analysis of the bar was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increaing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results.

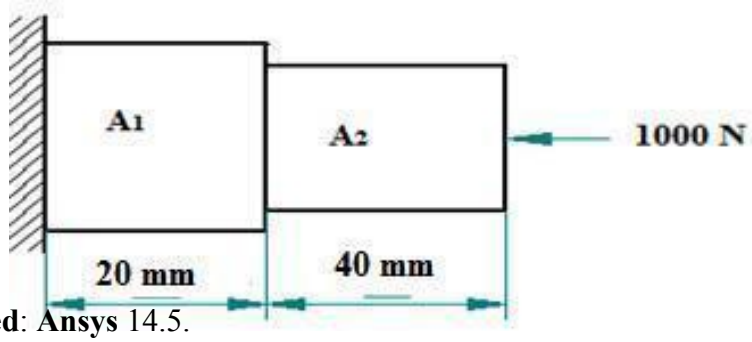
Experiment No: 8 **Date:**

AIM:

To perform displacement and stress analysis for the given stepped bar using Ansys simulation and analytical expressions.

Problem Description:

Find nodal displacement, stress in the element & reaction forces for the following problem. Given Data: E = 2x 10^5 N /mm^2, γ= 0.3 (Poisson's Ratio).A1 = 40 mm^2 , A2 = 20 mm^2



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –Link –3D finit stn 180 –ok – close.

Real constants –Add –ok –Real constant set no –1 –c/s area –40 – ok. Add –ok –Real constant set no –2 –c/s area – 20 –ok.

Material Properties –Material models –Structural –Linear –Elastic –Isotropic –EX – 2e5 –ok - close

Modeling –Create –Nodes –In Active CS –Apply (first node is Created) –x, y, z location in CS –20, 0, 0 –Apply (second node is Created) - x, y, z location in CS – 60, 0, 0 (third node is Created).

Modeling –Create –Elements –Auto numbered –Thru Nodes –pick 1 & 2 –Apply - pick 2 & 3 (elements are Created through nodes).

Step 4: Solution

Define loads –Apply –Structural –Displacement –on Nodes - pick node 1 –Apply –

DOFs to be constrained –All DOF –ok.

Define loads –Apply –Structural –Force/Moment –on Nodes - pick node 3 –Apply – direction of For/Mom –FX –Force/Moment value –1000 (-ve value) –ok.

Solve –Current LS –ok (Solution is done is displayed) –close**.**

Step 5: General Post Processor

Element table –Define table –Add –_Results–BydataSequence item‘num–LS–LS1 –ok.

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –LS1 – Elem table item at node J –LS1 –ok (Line Stress diagram will be displayed).

List Results –Reaction Solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

List Results –Nodal Solution –DOF solution –Displacement Vector Sum –ok. (Nodal solution will be displayed with the node numbers).

List Results –Nodal loads –items to be listed –All items –ok (Nodal loads will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed shape –def+undeformed-ok.

Particulars	Ansys			Theoretical		
	Node1	Node2	Node3	Node1	Node2	Node3
Deformation						
Stress						
Reaction						

Results:

The analysis of the bar was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increaing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results.

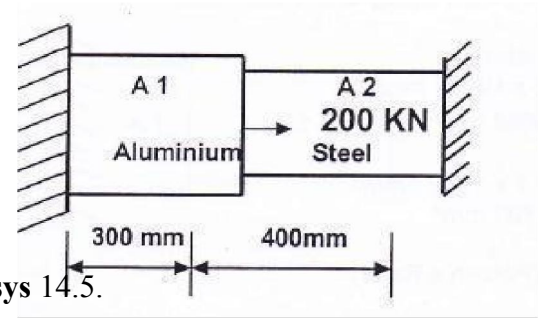
Experiment No: 9 **Date:**

AIM:

To perform displacement and stress analysis for the given stepped bar using Ansys simulation and analytical expressions.

Problem Description:

Find nodal displacement, stress in each element & reaction forces for the following problem Given Data: 1) $E_1 = 70x10^3$ N/mm^2, $A_1 = 2400$ mm^2. 2) $E_2 = 200 \times 10^3$ N / mm^2, $A_2 = 600$ mm^2 ,$\gamma = 0.3$ (Poisson's Ratio)



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –Link –3D finit stn 180 –ok – close.

Real constants –Add –ok –Real constant set no –1 –c/s area – 2400 –ok. Add –ok –Real constant set no –2 – c/s area –600 –ok.

Material Properties –Material Models –Structural –Linear –Elastic –Isotropic –EX – 70e3 –PRXY –0.3 - ok

Material –New model –Define material ID –2 –ok –Structural –Linear –Elastic – Isotropic –EX –200e3 –PRXY –0.3 - ok –close.

Modeling –Create –Nodes –In Active CS –Apply (first node is Created) –x, y, z location in CS –300, 0, 0 –Apply (second node is Created) - x, y, z location in CS –700, 0, 0 (third node is Created).

Modeling –Create –Elements –Auto numbered –Thru Nodes –pick 1 & 2 –ok Elements Attributes- Change Real Constant Set No 2 & Material No 2- Ok- Elements – Auto Numbered - Thru Nodes - Pick 2 & 3 Node-Apply-0k.

Step 4: Solution

Define loads –Apply –Structural –Displacement –on Nodes- pick node 1 & 3 –Apply –DOFs to be constrained –All DOF –ok.

Define loads –Apply –Structural –Force/Moment –on Nodes- pick node 2 –Apply – direction of For/Mom –FX –Force/Moment value –200000 (+ve value) –ok.

Solve –Current LS –ok (Solution is done is displayed) –close**.**

Step 5: General Post Processor

Element table –Define table –Add –_Resultem's–BydataSequence inum –LS –LS1 –ok.

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –LS1 – Elem table item at node J –LS1 –ok (Line Stress diagram will be displayed).

List Results –Reaction Solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

List Results –Nodal Solution –DOF solution –Displacement Vector Sum –ok. (Nodal solution will be displayed with the node numbers).

List Results –Nodal loads –items to be listed –All items –ok (Nodal loads will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed shape –def+undeformed-ok.

Comparison between theoretical and Ansys values:

Particulars	Ansys			Theoretical		
	Node1	Node2	Node3	Node1	Node2	Node3
Deformation						
Stress						
Reaction						

Results:

The analysis of the bar was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increaing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results.

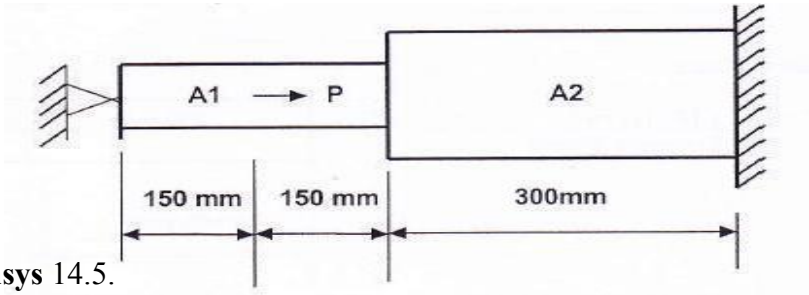
Experiment No: 10 **Date:**

AIM:

To perform displacement and stress analysis for the given stepped bar using Ansys simulation and analytical expressions.

Problem Description:

Consider the bar loaded as shown. Determine the following
1)Nodal displacement, 2)Stress in the element, 3)Reaction forces. Given Data: P = 300 KN, E = $200x10^9$ N/m^2. γ= 0.3 (Poisson's Ratio) ,A_1 = 250 mm^2, A_2 = 400 mm^2



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –Link –3D finit stn 180 –ok – close.

Real Constants –Add –ok –Real constant set no –1 –c/s area –250 –ok Add –ok –Real constant set no – 2 –c/s area –400 –ok

Material Properties –Material Models –Structural –Linear –Elastic – Isotropic –EX – 200e3 –PRXY –0.3 - ok

Modeling –Create –Nodes –In Active CS –Apply (first node is Created) – x, y, z location in CS –150, 0, 0 –Apply (second node is Created) - x, y, z location in CS –300, 0, 0 –Apply (third node is Created), x, y, z location in CS –600, 0, 0 –ok (fourth node is Created).

Modeling –Create –Elements –Auto numbered –Thru Nodes –pick 1 & 2 – Apply - pick 2 & 3 –ok.

Modeling –Create –Elements –Element Attributes –Change Real Constant Set No 2 – ok - pick 3 & 4 (elements are Created through nodes).

Step 4: Solution

Define loads –Apply –Structural –Displacement –on Nodes - pick node 1 & 4 –Apply –DOFs to be constrained –All DOF –ok.

Define loads –Apply –Structural –Force/Moment –on Nodes - pick node 2 –Apply – direction of For/Mom –FX –Force/Moment value –300e3 (+ve value) –ok.

Solve –Current LS –ok (Solution is done is displayed) –close**.**

Step 5: General Post Processor

Element table –Define table –Add –_Results–BydataSequence item‘num–LS–LS1–ok.

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –LS1 – Elem table item at node J –LS1 –ok (Line Stress diagram will be displayed).

List Results –Reaction solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

List Results –Nodal solution –DOF solution –Displacement Vector Sum –ok. (Nodal solution will be displayed with the node numbers).

List Results –Nodal loads –items to be listed –All items –ok (Nodal loads will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed shape –def+undeformed-ok.

Comparison between theoretical and Ansys values:

Particulars	Ansys				Theoretical			
	Node1	Node2	Node3	Node4	Node1	Node2	Node3	Node4
Deformation								
Stress								
Reaction								

Results:

The analysis of the bar was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increaing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results.

Experiment No: 11 **Date:**

AIM:

To perform displacement and stress analysis for the given stepped bar using Ansys simulation and analytical expressions.

Problem Description:

An axial load P = 300 x 10^3 N is applied at 20 °C to the rod as shown. The temperature is raised to 60^0c. Determine the nodal displacement, stress in the element, reaction forces.

Given Data:

1: Aluminum:

E = 70 x 10^9 N / m^2.

γ= 0.3 (Poisson'sRatio)

A = 900 mm^2

α = 23 x10^{-6} °C

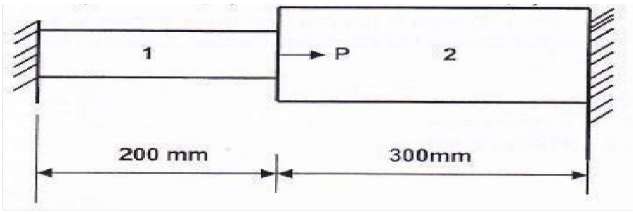
2: Steel:

E = 200x10^9N/m^2

γ= 0.3 (Poisson'sRatio)

A = 1200 mm^2

α = 11.7 x10^{-6} °c



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –Link –3D finit stn 180 –ok – close.

Real constants –Add –ok –Real constant set no –1 –c/s area –900 –ok

Add –ok –Real constant set no –2 –c/s area –1200 –ok –close.

Material Properties –Material models –Structural –Linear –Elastic –Isotropic –EX – 70e3 –PRXY –0.3 –ok

Thermal Expansion - Secant Coefficient - lsotropic - ALPX-23E-6 –ok.

Material - Define material ID –2 –ok —Structural –Linear –Elastic –Isotropic –EX – 200e3 –PRXY –0.3 –ok

Thermal Expansion-Secant Coefficient - lsotropic –ALPX -11.7E-6-Ok

Modeling –Create –Nodes –In Active CS –Apply (first node is Created) –x, y, z location in CS –200, 0, 0 –Apply (second node is Created) - x, y, z location in CS –500, 0, 0 –Apply (third node is Created)

Modeling –Create –Elements –Auto numbered –Thru Nodes –pick 1 & 2 –ok - Elements Attributes- Change Real Constant Set No 2 & Material No 2- Ok- Elements – Auto Numbered - Thru Nodes - Pick 2 & 3 Node -Apply- 0k.

Step 4: Solution

Define loads –Settings –Reference Temperature –20 - Ok.

Define Loads - Apply-Structural –Temperature - On Elements - Select Both Elements - Apply - VAL 1 Temperature at Location N = 60 –ok.

Define Loads - Apply - Structural - Displacement –On Nodes - Pick Node No 1 & 3 - Apply -All DOF -Apply - OK.

Define Loads –Apply –Structural - Force / Moments –On Nodes - Pick 2nd Node - Apply - Select FX = 300e3 - Apply - Ok.

Solve –Current LS –ok (Solution is done is displayed) –close**.**

Step 5: General Post Processor

Element table –Define table –Add –_Results–BydataSequence item‘num–LS–LS1–ok.

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –LS1 – Elem table item at node J –LS1 –ok (Line Stress diagram will be displayed).

Element Table - List Element Table - Select Stress - Ok.

List Results –Reaction Solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

List Results –Nodal Solution –DOF solution –Displacement Vector Sum –ok. (Nodal solution will be displayed with the node numbers).

List Results –Nodal loads –items to be listed –All items –ok (Nodal loads will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed shape –def+undeformed-ok.

Comparison between theoretical and Ansys values:

Particulars	Ansys				Theoretical			
	Node1	Node2	Node3	Node4	Node1	Node2	Node3	Node4
Deformation								
Stress								
Reaction								

Results:

The analysis of the stepped bar was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increasing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results.

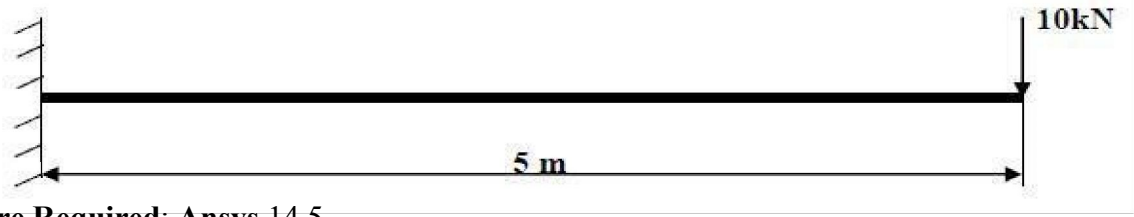
EXPT;11 Stress analysis of Beams

AIM:

Draw the shear force and bending moment diagrams for the given beam due to applied load .

Problem Description:

Compute the Shear force and bending moment diagrams for the beam shown. Assume rectangular c/s area of 0.2 m * 0.3 m, Young's modulus of 210 GPa, Poisson's ratio 0.27.



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –BEAM –2 noded 188 –ok- close.

Material Properties –Material Models –Structural –Linear –Elastic – Isotropic –EX – 210e3 –PRXY –0.27 –ok –close.

Sections –Beam –Common Section –B = 200, H = 300 –ok.

Modeling –Create –Nodes –In Active CS –Apply (first node is created) – x, y, z location in CS –5000, 0, 0 –ok (second node is Created).

Create –Elements –Auto numbered –Thru Nodes –pick 1 & 2 –ok (elements are created through nodes).

Step 4: Solution

Define loads –Apply –Structural –Displacement –on Nodes - pick node 1 – Apply – DOFs to be constrained –ALL DOF –ok.

Define loads –Apply –Structural –Force/Moment –on Nodes - pick node 2 –Apply – direction of For/Mom –FY –Force/Moment value - -10000 (-ve value) –ok.

Solve –Current LS –ok (Solution is done is displayed) –close.

Step 5: General Post Processor

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Nodal solu –DOF solution –displacement vector sum – ok.

Element table –Define table –Add –_Results–BydataSequence item‘num–SMISC –SMISC, 6 –Apply, By Sequence num –SMISC –SMISC, 19 –Apply, By Sequence num – SMISC –SMISC, 2 –Apply, By Sequence num –SMISC –SMISC, 15 –ok – close.

NOTE: For Shear Force Diagram use the combination SMISC 6 & SMISC 19, for Bending Moment Diagram use the combination SMISC 3 & SMISC 16.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –SMIS6 –Elem table item at node J –SMIS19 –ok (Shear force diagram will be displayed).

Plot Results –Contour plot –Line Element Results –Elem table item at node I –SMIS2 –Elem table item at node J –SMIS15 –ok (bending moment diagram will be displayed).

List Results –reaction solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

List Results –Nodal loads –items to be listed –All items –ok (Nodal loads will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed results –DOF solution –USUM –ok.

Comparison b/w Theoretical & Ansys Results

Particulars	Ansys		Theoretical	
	Maximum	Minimum	Maximum	Minimum
Shear force				
Bending Moment				

Results:

The analysis of the cantilever Beam was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increaing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results.

Experiment No: 12 **Date:**

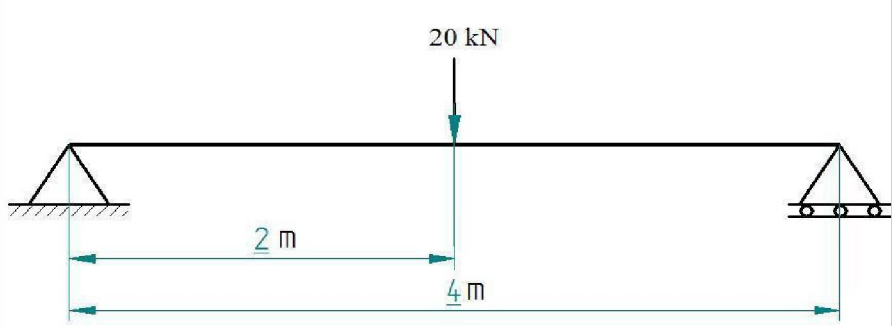
Stress analysis of Beams

AIM:

Draw the shear force and bending moment diagrams for the given beam due to applied load.

Problem Description:

Compute the shear force and bending moment diagrams for the beam shown Assume rectangular c/s area of 0.2 m * 0.3 m, Young's modulus of 210 GPa, Poisson's ratio 0.27.



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL –ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –BEAM –2 noded 188 –ok- close.

Material Properties –Material Models –Structural –Linear –Elastic – Isotropic –EX – 210e3 –PRXY –0.27 –ok –close.

Sections –Beam –Common Section –B = 200, H = 300 –ok.

Modeling –Create –Keypoints –In Active CS –Apply (first node is Created) –x, y, z location in CS –2000, 0, 0 - Apply (second node is Created) –4000, 0, 0 –ok - (third node is Created).

Modeling –Create –Lines –Straight lines–In Active Coord –pick keypoints 1 & 2, pick keypoints 2 & 3 –ok.

Meshing –Size cntrls –Manual size –Global –Size –Element edge length –5 –ok.

Meshing –Mesh –Lines –Pick all –ok.

Step 4: Solution

Define loads –Apply –Structural –Displacement –on keypoint - pick keypoint 1 – Apply –DOFs to be constrained –UX, UY, UZ, ROTX, ROTY –Apply –pick keypoint 3 –Apply

–DOFs to be constrained –UY–ok.

Define loads –Apply –Structural –Force/Moment –on keypoint - pick keypoint 2 – Apply –direction of For/Mom –FY –Force/Moment value –-20e3 (-ve value) –ok.

Solve –Current LS –ok (Solution is done is displayed) –close.

Step 5: General Post Processor

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Nodal solu –DOF solution –displacement vector sum -ok.

Element table –Define table –Add –_Results–BydataSequence item‘num–SMISC –SMISC, 6 –Apply, By Sequence num –SMISC –SMISC, 19 –Apply, By Sequence num –SMISC –SMISC, 3 –Apply, By Sequence num –SMISC –SMISC, 16 –ok – close.

NOTE: For Shear Force Diagram use the combination SMISC 6 & SMISC 19, for Bending Moment Diagram use the combination SMISC 3 & SMISC 16.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –SMIS6 –Elem table item at node J –SMIS19 –ok (Shear force diagram will be displayed).

Plot Results –Contour plot –Line Element Results –Elem table item at node I –SMIS3– Elem table item at node J –SMIS16 –ok (Bending moment diagram will be displayed). **List Results** –reaction solution –items to be listed –All items –ok (Reaction forces will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed results –DOF solution –USUM –ok.

Comparison b/w Theoretical & Ansys Results

Particulars	Ansys		Theoretical	
	Maximum	Minimum	Maximum	Minimum
Shear force				
Bending Moment				

Results:

The analysis of the cantilever Beam was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increaing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results.

Experiment No: 13 **Date:**

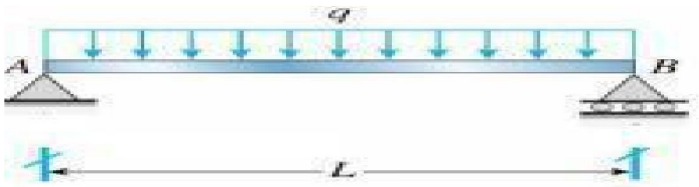
Stress analysis of Beams

AIM:

Draw the shear force and bending moment diagrams for the given beam due to applied load.

Problem Description:

Draw the shearforce and bending moment diagram for the beam loaded as shown in figure. Assume rectangular c/s area of 0.2 m * 0.3 m, E = 200GPa, Poisson's ratio = 0.3, Length (L) = 2m, q = 10kN/m.



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –BEAM –2 noded 188 –ok- close.

Material Properties –Material models –Structural –Linear –Elastic – Isotropic –EX – 200e3 –PRXY –0.3 –ok –close.

Sections –Beam –Common Section –B = 200, H = 300 –ok.

Modeling –Create –Keypoints –In Active CS –Apply (first node is Created) –x, y, z location in CS –2000, 0, 0 –ok (second node is Created).

Modeling –Create –Lines –Straight lines–in Active Coord –pick keypoints 1 & 2, pick ok.

Meshing –Size Cntrls –Manual size –Global –Size –No of element divisions –100 –ok.

Meshing –Mesh –Lines –Pick all –ok.

Step 4: Solution

Define loads –Apply –Structural –Displacement –on keypoint - pick keypoint 1 – Apply –DOFs to be constrained –UX, UY, UZ, ROTX, ROTY –Apply – pick keypoint 2 –Apply –DOFs to be constrained –UY–ok.

Define loads –Apply –Structural –on beams –select full line –Load key –2 - Pressure value at node I –10e3 - ok.

Solve –Current LS –ok (Solution is done is displayed) –close.

Step 5: General Post Processor

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Nodal solu –DOF solution –displacement vector sum –ok.

Element table –Define table –Add –Results–BydataSequence item‘num–SMISC –SMISC, 6 –Apply, By Sequence num –SMISC –SMISC, 19 –Apply, By Sequence num –SMISC –SMISC, 3 –Apply, By Sequence num –SMISC –SMISC, 16 –ok – close.

NOTE: For Shear Force Diagram use the combination SMISC 6 & SMISC 19, for Bending Moment Diagram use the combination SMISC 3 & SMISC 16.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –SMIS6 –Elem table item at node J –SMIS19 –ok (Shear force diagram will be displayed).

Plot Results –Contour plot –Line Element Results –Elem table item at node I –SMIS3 –Elem table item at node J –SMIS16 –ok (bending moment diagram will be displayed).

List Results –reaction solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

List Results –Nodal loads –items to be listed –All items –ok (Nodal loads will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed results –DOF solution –USUM –ok.

Comparison b/w Theoretical & Ansys Results

	Ansys		**Theoretical**	
	Maximum	**Minimum**	**Maximum**	**Minimum**
Shear force				
Bending Moment				

Results:

The analysis of the Simply Supported Beam was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increaing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results

Experiment No: 14 **Date:**

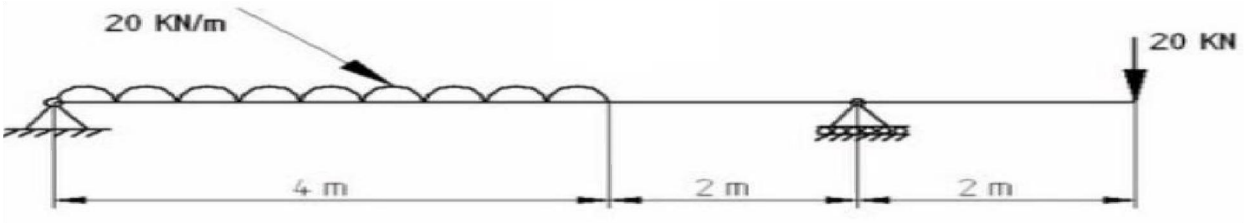
Stress analysis of Beams

AIM:

Draw the shear force and bending moment diagrams for the given beam due to applied load.

Problem Description:

Draw the shear force and bending moment diagram for the beam loaded as shown in figure. Assume rectangular c/s area of 0.2 m * 0.3 m, E = 200GPa, Poisson's ratio = 0.3.



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –BEAM –2 noded 188 –ok- close.

Material Properties –Material models –Structural –Linear –Elastic – Isotropic –EX – 200e3 –PRXY –0.3 –ok –close.

Sections –Beam –Common Section –B = 200, H = 300 –ok.

Modeling –Create –Keypoints –In Active CS –Apply (first node is Created) –x, y, z location in CS –4000, 0, 0 - Apply (second node is Created) –6000, 0, 0 –ok - (third node is Created) - 8000, 0, 0 –ok - (fourth node is Created).

Modeling –Create –Lines –Straight lines–in Active Coord –pick keypoints 1 & 2, pick keypoints 2 & 3, pick keypoints 3 & 4 –ok.

Meshing –Size cntrls –Manual size –Global –Size –Element edge length –5 –ok.

Meshing –Mesh –Lines –Pick all –ok.

Step 4: Solution

Define loads –Apply –Structural –Displacement –on keypoint - pick keypoint 1 – Apply –DOFs to be constrained –UX, UY, UZ, ROTX, ROTY –Apply –pick keypoint 3 –Apply –DOFs to be constrained –UY–ok.

Define loads –Apply –Structural –Force/Moment –on keypoint - pick keypoint 4 – Apply –direction of For/Mom –FY –Force/Moment value –-20e3 (-ve value) –ok.

Define loads –Apply –Structural –on beams –select box option –select from 1^{st} keypoint to 2^{nd} –Load key –2 - Pressure value at node I –20e3 - ok.

Solve –Current LS –ok (Solution is done is displayed) –close.

Step 5: General Post Processor

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Nodal solu –DOF solution –displacement vector sum –ok.

Element table –Define table –Add –_Results–BydataSequence item‘num–SMISC –SMISC, 6 –Apply, By Sequence num –SMISC –SMISC, 19 –Apply, By Sequence num –SMISC –SMISC, 3 –Apply, By Sequence num –SMISC –SMISC, 16 –ok – close.

NOTE: For Shear Force Diagram use the combination SMISC 6 & SMISC 19, for Bending Moment Diagram use the combination SMISC 3 & SMISC 16.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –SMIS6 –Elem table item at node J –SMIS19 –ok (Shear force diagram will be displayed).

Plot Results –Contour plot –Line Element Results –Elem table item at node I –SMIS3 –Elem table item at node J –SMIS16 –ok (bending moment diagram will be displayed).

List Results –Reaction solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed results –DOF solution –USUM –ok.

Comparison b/w Theoretical & Ansys

	Ansys		**Theoretical**	
	Maximum	**Minimum**	**Maximum**	**Minimum**
Shear force				
Bending Moment				

Results: The analysis of the Simply Supported Beam was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increaing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results

Experiment No: 15 **Date:**

Stress analysis of Beams

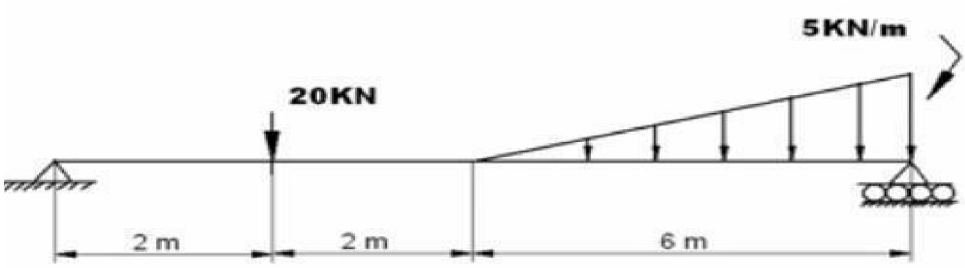
AIM:

Draw the shear force and bending moment diagrams for the given beam due to applied load.

Problem Description:

Draw the shear force and bending moment diagram for the beam loaded as shown in figure. Assume rectangular c/s area of 0.2 m * 0.3 m, E = 200GPa,

Poisson's ratio = 0.3.



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File –clear and start new –do not read file –ok –yes.

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL - ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –BEAM –2 noded 188 –ok- close.

Material Properties –Material models –Structural –Linear –Elastic –Isotropic –EX – 200e3 –PRXY –0.3 –ok –close.

Sections –Beam –Common Section –B = 200, H = 300 –ok.

Modeling –Create –Keypoints –In Active CS –Apply (first node is Created) –x, y, z location in CS –2000, 0, 0 - Apply (second node is Created) –4000, 0, 0 –ok - (third node is Created) - 10000, 0, 0 –ok - (fourth node is Created).

Modeling –Create –Lines –Straight lines–in Active Coord –pick keypoints 1 & 2, pick keypoints 2 & 3, pick keypoints 3 & 4 –ok.

Meshing –Size cntrls –Manual size –Global –Size –No of element divisions –100 –ok.

Meshing –Mesh –Lines –Pick all –ok.

Step 4: Solution

Define loads –Apply –Structural –Displacement –on keypoint - pick keypoint 1 – Apply –DOFs to be constrained –UX, UY, UZ, ROTX, ROTY –Apply –pick keypoint 4 –Apply –DOFs to be constrained –UY–ok.

Define loads –Apply –Structural –Force/Moment –on keypoint - pick keypoint 2 –

Apply –direction of For/Mom –FY –Force/Moment value –-20e3 (-ve value) –ok.

Define loads –Apply –Structural –on beams –select box option –select from 1st keypoint to 2nd –Load key –2 - Pressure value at node I –0 - Pressure value at node J –5e3 - ok.

Solve –Current LS –ok (Solution is done is displayed) –close.

Step 5: General Post Processor

Plot Results –Deformed Shape –def+undeformed –ok.

Plot Results –Contour plot –Nodal solu –DOF solution –displacement vector sum –ok.

Element table –Define table –Add –_Results–BydataSequence item‘num–SMISC –SMISC, 6 –Apply, By Sequence num –SMISC –SMISC, 19 –Apply, By Sequence num –SMISC –SMISC, 3 –Apply, By Sequence num –SMISC –SMISC, 16 –ok – close.

NOTE: For Shear Force Diagram use the combination SMISC 6 & SMISC 19, for Bending Moment Diagram use the combination SMISC 3 & SMISC 16.

Plot Results –Contour plot –Line Element Results –Elem table item at node I –SMIS6 –Elem table item at node J –SMIS19 –ok (Shear force diagram will be displayed).

Plot Results –Contour plot –Line Element Results –Elem table item at node I –SMIS3 –Elem table item at node J –SMIS16 –ok (bending moment diagram will be displayed).

List Results –reaction solution –items to be listed –All items –ok (reaction forces will be displayed with the node numbers).

Step 6: PlotCtrls –Animate –Deformed results –DOF solution –USUM –ok.

Comparison b/w Theoretical & Ansys Results

	Ansys		**Theoretical**	
	Maximum	**Minimum**	**Maximum**	**Minimum**
Shear force				
Bending Moment				

Results:

The analysis of the Simply Supported Beam was carried out using the Ansys simulation and the software results were compared with theoretical or analytical results.

Verification/Validation: Verify the Ansys results by increaing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results

Experiment No: 16 **Date:**

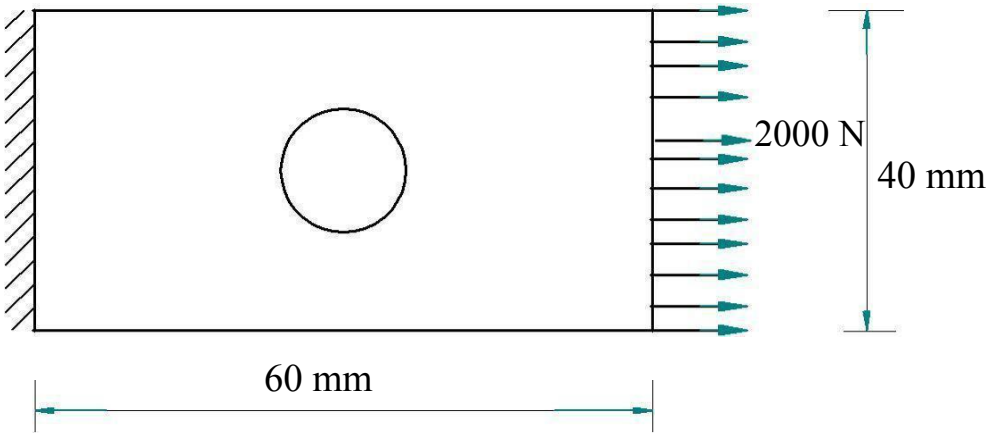
Stress Analysis of a Rectangular Plate with a circular Hole

AIM:

To determine the stress acting on a rectangular plate with a circular hole due to the applied external load.

Problem Description:

In the plate with a hole under plane stress, find deformed shape of the hole and determine the maximum stress distribution along A-B. E = 210GPa, t = 1 mm, Poisson‘s0.3, Diameter of the circle =10 mm.



Software Required: **Ansys** 14.5.

Procedure:

Step 1: Ansys Utility Menu

File - Change Job name

File - Change Title

Step 2: Ansys Main Menu –Preferences

Select –STRUCTURAL –ok

Step 3: Preprocessor

Element type –Add/Edit/Delete –Add –Solid –Quad 4 node 182 –ok –Option – element behavior K3 –Plane stress with thickness –ok –close.

Real constants –Add –ok –Real constant set no –1 –Thickness –1 –ok.

Material Properties –material models –Structural –Linear –Elastic –Isotropic –EX – 210e3 –PRXY –0.3 –ok –close.

Modeling –Create –Area –Rectangle –by dimensions –X1, X2, Y1, Y2 –0, 60, 0, 40 –ok.

Modeling –Create –Area –Circle –solid circle –X, Y, radius –30, 20, 5 –ok.

Modeling –Operate –Booleans –Subtract –Areas –pick area which is not to be deleted (rectangle) –Apply –pick area which is to be deleted (circle) –ok.

Meshing –Mesh Tool –Mesh Areas –Quad –Free –Mesh –pick all –ok.

Meshing –Mesh Tool –Refine–pick all –Level of refinement –3 –ok.

Step 4: Solution

Define loads –Apply –Structural –Displacement –on Nodes –select box –drag the left side of the area –Apply –DOFs to be constrained –ALL DOF

Define loads –Apply –Structural –Force/Moment –on Nodes –select box –drag the right side of the area –Apply –direction of For/Mom –FX –Force/Moment value –2000 (+ve value) –ok.

Solve –Current LS –ok (Solution is done is displayed) –close.

Step 5: General Post Processor

Plot Results –Deformed Shape –def+undeformed –ok.

Plot results –Contour plot –Element solu –Stress –Von Mises Stress –ok (the stress distribution diagram will be displayed).

Step 6: PlotCtrls –Animate –Deformed shape –def+undeformed-ok

Result: Thus the performance of the stress analysis of a Rectangular Plate with a circular hole was analyzed and animated.

Verification/Validation: Verify the Ansys results by increaing number of nodes and elements to match the theoretical or analytical results.

Conclusion: Ansys simulation and the software results are near to theoretical or analytical results