

B.TECH AUTOMOBILE ENGINEERING (R 2019)

SYLLABUS & CURRICULUM



DEPARTMENT OF AUTOMOBILE ENGINEERING
SCMS SCHOOL OF ENGINEERING AND TECHNOLOGY
VIDYA NAGAR, PALISSERY, KARUKUTTY, ERNAKULAM – 683 576

SEMESTER 1

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MAT101	LINEAR ALGEBRA AND CALCULUS	3-1-0	4	4
B 1/2	PHT110	ENGINEERING PHYSICS	3-1-0	4	4
	CYT100	ENGINEERING CHEMISTRY	3-1-0	4	4
C 1/2	EST100	ENGINEERING MECHANICS	2-1-0	3	3
	EST110	ENGINEERING GRAPHICS	2-0-2	4	3
D 1/2	EST120	BASICS OF CIVIL & MECHANICAL ENGINEERING	4-0-0	4	4
	EST130	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	4-0-0	4	4
E	HUT101	LIFE SKILLS	2-0-2	4	--
S 1/2	PHL120	ENGINEERING PHYSICS LAB	0-0-2	2	1
	CYL120	ENGINEERING CHEMISTRY LAB	0-0-2	2	1
T 1/2	ESL120	CIVIL & MECHANICAL WORKSHOP	0-0-2	2	1
	ESL130	ELECTRICAL & ELECTRONICS WORKSHOP	0-0-2	2	1
TOTAL				23/24 *	17

SEMESTER 2

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MAT102	<u>VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND TRANSFORMS</u>	3-1-0	4	4
B 1/2	PHT110	<u>ENGINEERING PHYSICS B</u>	3-1-0	4	4
	CYT100	<u>ENGINEERING CHEMISTRY</u>	3-1-0	4	4
C 1/2	EST100	<u>ENGINEERING MECHANICS</u>	2-1-0	3	3
	EST110	<u>ENGINEERING GRAPHICS</u>	2-0-2	4	3
D 1/2	EST120	<u>BASICS OF CIVIL & MECHANICAL ENGINEERING</u>	4-0-0	4	4
	EST130	<u>BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING</u>	4-0-0	4	4
E	HUT102	<u>PROFESSIONAL COMMUNICATION</u>	2-0-2	4	--
F	EST102	<u>PROGRAMMING IN C</u>	2-1-2	5	4
S 1/2	PHL120	<u>ENGINEERING PHYSICS LAB</u>	0-0-2	2	1
	CYL120	<u>ENGINEERING CHEMISTRY LAB</u>	0-0-2	2	1
T 1/2	ESL120	<u>CIVIL & MECHANICAL WORKSHOP</u>	0-0-2	2	1
	ESL130	<u>ELECTRICAL & ELECTRONICS WORKSHOP</u>	0-0-2	2	1
TOTAL				28/29	21

SEMESTER 3

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MAT201	<u>PARTIAL DIFFERENTIAL EQUATION AND COMPLEX ANALYSIS</u>	3-1-0	4	4
B	MET201	<u>MECHANICS OF SOLIDS</u>	3-1-0	4	4
C	AUT201	<u>AUTOMOTIVE CHASSIS</u>	3-1-0	4	4
D	AUT203	<u>ENGINEERING THERMODYNAMICS</u>	3-1-0	4	4
E 1/2	EST200	<u>DESIGN & ENGINEERING</u>	2-0-0	2	2
	HUT200	<u>PROFESSIONAL ETHICS</u>	2-0-0	2	2
F	MCN201	<u>SUSTAINABLE ENGINEERING</u>	2-0-0	2	--
S	AUL201	<u>AUTOMOBILE LAB I</u>	0-0-3	3	2
T	MEL203	<u>MATERIALS TESTING LAB</u>	0-0-3	3	2
R/M	VAC	REMEDIAL/MINOR COURSE	3-1-0	4 *	4
TOTAL				26/30	22/26

NOTE:

1. Design & Engineering and Professional Ethics shall be offered in both S3 and S4. Institutions can advise students belonging to about 50% of the number of branches in the Institution to opt for Design & Engineering in S3 and Professional Ethics in S4 & vice versa.
2. *All Institutions shall keep 4 hours exclusively for Remedial class/Minor course (Thursdays from 3 to 5 PM and Fridays from 2 to 4 PM). If a student does not opt for minor programme, he/she can be given remedial class.

SEMESTER IV

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MAT202	PROBABILITY, STATISTICS AND NUMERICAL METHODS	3-1-0	4	4
B	AUT202	FLUID MECHANICS AND MACHINERY	3-1-0	4	4
C	AUT204	AUTO POWER PLANT	3-1-0	4	4
D	AUT206	AUTOMOTIVE TRANSMISSION	3-1-0	4	4
E 1/2	EST200	DESIGN & ENGINEERING	2-0-0	2	2
	HUT200	PROFESSIONAL ETHICS	2-0-0	2	2
F	MCN202	CONSTITUTION OF INDIA	2-0-0	2	--
S	MEL202	FM & HM LAB	0-0-3	3	2
T	AUL202	AUTOMOBILE LAB II	0-0-3	3	2
R/M/H	VAC	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				26/30	22/26

NOTE:

- Design & Engineering and Professional Ethics shall be offered in both S3 and S4. Institutions can advise students belonging to about 50% of the number of branches in the Institution to opt for Design & Engineering in S3 and Professional Ethics in S4 & vice versa.
- *All Institutions should keep 4 hours exclusively for Remedial class/Minor course (Thursdays from 3 to 5 PM and Fridays from 2 to 4 PM). If a student doesnot opt for minor programme, he/she can be given remedial class.

SEMESTER 5

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	AUT301	THEORY OF MACHINES	3-1-0	4	4
B	AUT303	MANUFACTURING PROCESS	3-1-0	4	4
C	AUT305	HYBRID AND FUEL CELL VEHICLES	3-1-0	4	4
D	AUT307	MATERIAL SCIENCE AND METALLURGY	3-1-0	4	4
E 1/2	HUT300	INDUSTRIAL ECONOMICS & FOREIGN TRADE	3-0-0	3	3
	HUT310	MANAGEMENT FOR ENGINEERS	3-0-0	3	3
F	MCN301	DISASTER MANAGEMENT	2-0-0	2	--
S	MUL331	PRODUCTION ENGINEERING LAB	0-0-3	3	2
T	MEL333	THERMAL ENGINEERING LAB-I	0-0-3	3	2
R/M/H	VAC	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				27/31	23/27

NOTE:

1. Industrial Economics & Foreign Trade and Management for Engineers shall be offered in both S5 and S6. Institutions can advise students belonging to about 50% of the number of branches in the Institution to opt for Industrial Economics & Foreign Trade-in S5 and Management for Engineers in S6 and vice versa.
2. *All Institutions should keep 4 hours exclusively for Remedial class/Minor/Honours course (Tuesdays from 3 to 5 PM and Wednesdays from 3 to 5 PM). If a student does not opt for minor/honours programme, he/she can be given remedialclass.

SEMESTER 6

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MET302	HEAT & MASS TRANSFER	3-1-0	4	4
B	AUT304	AUTOMOTIVE ELECTRICAL AND ELECTRONICS	3-1-0	4	4
C	AUT306	AUTOMOTIVE COMPONENTS DESIGN	3-1-0	4	4
D	AUTXXX	PROGRAM ELECTIVE I	2-1-0	3	3
E 1/2	HUT300	INDUSTRIAL ECONOMICS & FOREIGN TRADE	3-0-0	3	3
	HUT310	MANAGEMENT FOR ENGINEERS	3-0-0	3	3
F	AUT308	COMPREHENSIVE COURSE WORK	1-0-0	1	1
S	MEL332	COMPUTER AIDED DESIGN & ANALYSIS LAB	0-0-3	3	2
T	AUL334	AUTOMOBILE LAB III	0-0-3	3	2
R/M/H	VAC	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				25/29	23/27

PROGRAM ELECTIVE I

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
D	AUT312	TWO AND THREE WHEELED VEHICLE	2-1-0	3	3
	AUT322	NUMERICAL METHODS	2-1-0		
	AUT332	VEHICLE INSPECTION AND MAINTENANCE	2-1-0		
	AUT342	VEHICLE PERFORMANCE AND TESTING	2-1-0		
	AUT352	AUTOMOTIVE POLLUTION AND TESTING	2-1-0		
	AUT362	MECHATRONICS AND CONTROL SYSTEMS	2-1-0		
	AUT372	CAD /CAM	2-1-0		

NOTE:

1. Industrial Economics & Foreign Trade and Management for Engineers shall be offered in both S5 and S6. Institutions can advise students belonging to about 50% of the number of branches in the Institution to opt for Industrial Economics & Foreign Trade in S5 and Management for Engineers in S6 and vice versa.
2. *All Institutions should keep 4 hours exclusively for Remedial class/Minor/Honours course (Tuesdays from 3 to 5 PM and Wednesdays from 2 to 4 PM). If a student does not opt for minor/honours programme, he/she can be given remedial class.
3. Comprehensive Course Work: The comprehensive course work in the sixth semester of study shall have a written test of 50 marks. The written examination will be of objective type similar to the GATE examination and will be conducted by the University. **Syllabus for comprehensive examination shall be prepared by the respective BoS choosing any 5 core courses studied from semester 3 to 5.** The pass minimum for this course is 25. The course should be mapped with a faculty and classes shall be arranged for practising questions based on the core courses listed in the curriculum.

SEMESTER VII

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	AUT401	ADVANCED IC ENGINES	2-1-0	3	3
B	AUTXXX	PROGRAM ELECTIVE II	2-1-0	3	3
C	AUTXXX	OPEN ELECTIVE	2-1-0	3	3
D	MCN401	INDUSTRIAL SAFETY ENGINEERING	2-1-0	3	---
S	AUL411	AUTOMOBILE LAB IV	0-0-3	3	2
T	AUQ413	SEMINAR	0-0-3	3	2
U	AUD415	PROJECT PHASE I	0-0-6	6	2
R/M/H	VAC	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				24/28	15/19

PROGRAM ELECTIVE II

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
B	AUT413	ALETERNATE ENERGY SOURCES FOR AUTOMOBILE	2-1-0	3	3
	AUT423	VEHICLE AERODYNAMICS	2-1-0		
	AUT433	THEORY OF VIBRATIONS	2-1-0		
	AUT443	MARKETING MANAGEMENT	2-1-0		
	AUT453	DESIGN OF MACHINE ELEMENTS	2-1-0		
	AUT463	VEHICLE DESIGN DATA CHARACTERISTICS	2-1-0		
	AUT473	HEATING VENTILATION AND AIRCONDITIONING	2-1-0		

OPEN ELECTIVE (OE)

The open elective is offered in semester 7. Each program should specify the courses (maximum 5) they would like to offer as electives for other programs. The courses listed below are offered by **the Department of AUTOMOBILE ENGINEERING** for students of all undergraduate branches offered in the college.

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
C	AUT415	MODERN AUTOMOTIVE TECHNOLOGY	2-1-0	3	3
	AUT425	HYBRID AND ELECTRIC VEHICLES	2-1-0		
	AUT435	AUTOMOTIVE ERGONOMICS AND SAFETY	2-1-0		
	AUT445	AVG AND AUTONOMOUS VEHICLES	2-1-0		
	AUT455	COMPUTER SIMULATION AND ANALYSIS OF AUTOMOTIVE SYSTEMS	2-1-0		

SEMESTER VIII

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	AUT402	VEHICLE DYNAMICS	2-1-0	3	3
B	AUTXXX	PROGRAM ELECTIVE III	2-1-0	3	3
C	AUTXXX	PROGRAM ELECTIVE IV	2-1-0	3	3
D	AUTXXX	PROGRAM ELECTIVE V	2-1-0	3	3
T	AUT404	COMPREHENSIVE COURSE VIVA	1-0-0	1	1
U	AUD416	PROJECT PHASE II	0-0-12	12	4
R/M/H	VAC	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				25/29	17/21

PROGRAM ELECTIVE III

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
B	AUT414	SPECIAL TYPES OF VEHICLES	2-1-0	3	3
	AUT424	ENGINE AND VEHICLE MANAGEMENT SYSTEM	2-1-0		
	AUT434	ADVANCED METAL JOINING TECHNIQUES	2-1-0		
	AUT444	AGV AND AUTONOMOUS VEHICLE	2-1-0		
	AUT454	SUPPLY CHAIN MANAGEMENT	2-1-0		
	AUT464	AEROSPACE ENGINEERING	2-1-0		
	AUT474	METROLOGY AND MEASUREMENTS	2-1-0		

PROGRAM ELECTIVE IV

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
C	AUT416	OPERATIONS MANAGEMENT IN AUTO INDUSTRY	2-1-0	3	3
	AUT426	AUTOMOTIVE COMFORT AND SAFETY ENGINEERING	2-1-0		
	AUT436	PRODUCT DESIGN AND LIFECYCLE	2-1-0		

		MANAGEMENT			
	AUT446	ADVANCED AUTOMOTIVE MANUFACTURING MATERIALS	2-1-0		
	AUT456	TOTAL QUALITY MANAGEMENT	2-1-0		
	AUT466	VEHICLE MAINTENANCE	2-1-0		
	AUT476	MACHINE LEARNING	2-1-0		

PROGRAM ELECTIVE V

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
D	AUT418	VEHICLE TRANSPORT AND FLEET MANAGEMENT	2-1-0	3	3
	AUT428	VEHICLE BODY ENGINEERING AND SSFETY	2-1-0		
	AUT438	POWER PLANT ENGINEERING	2-1-0		
	AUT448	ADVANCED METAL JOINING TECHNIQUES	2-1-0		
	AUT458	SIMULATION AND ANALYSIS OF AUTO COMPONENTS	2-1-0		
	AUT468	HYDRAULICS AND PNEUMATICS	2-1-0		
	AUT478	ADVANCED METAL CASTING	2-1-0		

EST 120	BASICS OF CIVIL & MECHANICAL ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

Objective of this course is to provide an insight and inculcate the essentials of Civil Engineering discipline to the students of all branches of Engineering and to provide the students an illustration of the significance of the Civil Engineering Profession in satisfying the societal needs.

To introduce the students to the basic principles of mechanical engineering

Prerequisite: NIL

Course Outcomes: After completion of the course, the student will be able to

CO 1	Recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.
CO 2	Explain different types of buildings, building components, building materials and building construction
CO 3	Describe the importance, objectives and principles of surveying.
CO 4	Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps
CO 5	Discuss the Materials, energy systems, water management and environment for green buildings.
CO 6	Analyse thermodynamic cycles and calculate its efficiency
CO 7	Illustrate the working and features of IC Engines
CO 8	Explain the basic principles of Refrigeration and Air Conditioning
CO 9	Describe the working of hydraulic machines
CO 10	Explain the working of power transmission elements
CO 11	Describe the basic manufacturing, metal joining and machining processes

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	3	2	2	-	-	-	-
CO2	3	2	-	1	3	-	-	3	-	-	-	-
CO3	3	2	-	-	3	-	-	-	2	-	-	-

CO4	3	2	-	-	3	-	-	-	2	-	-	-
CO5	3	2	-	-	3	2	3	-	2	-	-	-
CO6	3	2										
CO7	3	1										
CO8	3	1										
CO9	3	2										
CO10	3	1										
CO11	3											

Assessment Pattern

	Basic Civil Engineering			Basic Mechanical Engineering		
Bloom's Category	Continuous Assessment		End Semester Examination (marks)	Continuous Assessment		End Semester Examination (marks)
	Test 1 marks	Test 2 marks		Test 1 marks	Test 2 marks	
Remember	5	5	10	7.5	7.5	15
Understand	20	20	40	12.5	12.5	25
Apply				5	5	10
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern:

There will be two parts; Part I – Basic Civil Engineering and Part II – Basic Mechanical Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts -

Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions:

Course Outcome CO1: *To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.*

1. Explain relevance of Civil engineering in the overall infrastructural development of the country.

Course outcome 2 (CO2) (One question from each module and not more than two)

Explain different types of buildings, building components, building materials and building construction

1. Discuss the difference between plinth area and carpet area.

Course outcome 3 (CO3) (One question from each module and not more than two)

Describe the importance, objectives and principles of surveying.

1. Explain the importance of surveying in Civil Engineering

Course outcome 4 (CO4) (One question from each module and not more than two)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps

1. Explain the civil engineering aspects of elevators, escalators and ramps in buildings

Course outcome 5 (CO5) (One question from each module and not more than two)

Discuss the Materials, energy systems, water management and environment for green buildings.

1. Discuss the relevance of Green building in society

Section II *Answer any 1 full question from each module. Each full question carries 10 marks*

Course Outcome 1 (CO1) (Two full question from each module and each question can have maximum 2 sub-divisions)

To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering

CO Questions

1. **a** List out the types of building as per occupancy. Explain any two, each in about five sentences.

b. Discuss the components of a building with a neat figure.

2. **a.** What are the major disciplines of civil engineering and explain their role in the infrastructural framework.

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country.

Course Outcome 2 (CO2) & Course Outcome 3 (CO3) (Two full question from each module and each question can have maximum 2 sub-divisions)

Explain different types of buildings, building components, building materials and building construction & Describe the importance, objectives and principles of surveying.

CO Questions

1. a. What are the different kinds of cement available and what is their use.
b. List the properties of good building bricks. Explain any five.
2. a. List and explain any five modern construction materials used for construction.
b. Explain the objectives and principles of surveying

Course outcome 4 (CO4) & Course outcome 5 (CO5) (Two full question from each module and each question can have maximum 2 sub-divisions)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps & Discuss the Materials, energy systems, water management and environment for green buildings.

CO Questions

1. a. Draw the elevation and plan of one brick thick wall with English bond
b. Explain the energy systems and water management in Green buildings
2. a. Draw neat sketch of the following foundations: (i) Isolated stepped footing;
(ii) Cantilever footing; and (iii) Continuous footing.

b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building

Course Outcome 6 (CO6):

1. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35°C, 0.1 MPa. The maximum temperature of the cycle is 1100°C. Find
 - i) Heat supplied per kg of air,
 - ii) Work done per kg of air,
 - iii) Cycle efficiencyTake $C_p = 1.005 \text{ kJ/kgK}$ and $C_v = 0.718 \text{ kJ/kgK}$
2. A Carnot cycle works with adiabatic compression ratio of 5 and isothermal expansion ratio of 2. The volume of air at the beginning of isothermal expansion is 0.3 m^3 . If the maximum temperature and pressure is limited to 550K and 21 bar, determine the minimum temperature in the cycle and efficiency of the cycle.
3. In an ideal diesel cycle, the temperature at the beginning and end of compression is 65°C and 620°C respectively. The temperature at the beginning and end of the expansion is 1850°C and 850 °C. Determine the ideal efficiency of the cycle.

4. Explain the concepts of CRDI and MPFI in IC Engines.

Course Outcome 7 (CO7)

1. With the help of a neat sketch explain the working of a 4 stroke SI engine
2. Compare the working of 2 stroke and 4 stroke IC engines
3. Explain the classification of IC Engines.

Course Outcome 8(CO8):

1. Explain the working of vapour compression refrigeration system.
2. With the help of suitable sketch explain the working of a split air conditioner.
3. Define: COP, specific humidity, relative humidity and dew point temperature.

Course Outcome 9 (CO9):

1. Explain the working of a single stage centrifugal pump with sketches.
2. With the help of a neat sketch, explain the working of a reciprocating pump.
3. A turbine is to operate under a head of 25 m at 200 rpm. The discharge is $9 \text{ m}^3/\text{s}$. If the overall efficiency of the turbine is 90%. Determine the power developed by the turbine.

Course Outcome 10 (CO10):

1. Explain the working of belt drive and gear drive with the help of neat sketches
2. Explain a single plate clutch.
3. Sketch different types of gear trains and explain.

Course Outcome 11 (CO11):

1. Describe the operations which can be performed using drilling machine.
2. Explain the functions of runners and risers used in casting.
3. With a neat sketch, explain the working and parts of a lathe.

Model Question Paper

QP CODE: EST120

page:3

Reg No: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: EST 120

Course Name: BASICS OF CIVIL AND MECHANICAL ENGINEERING

Max. Marks: 100

Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

PART I: BASIC CIVIL ENGINEERING

PART A

(Answer all questions. Each question carries 4 marks)

1. Explain relevance of Civil engineering in the overall infrastructural development of the country.
2. Discuss the difference between plinth area and carpet area.
3. Explain different types of steel with their properties.
4. What are the different kinds of cement available and what is their use?
5. Define bearing capacity of soil.

(5 x 4 = 20)

Part B

Answer one full question from each module.

MODULE I

- 6a. List out the types of building as per occupancy. Explain any two, each in about five sentences. (5)
- b. Discuss the components of a building with a neat figure. (5)

OR

- 7a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework. (5)
- b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country. (5)

MODULE II

- 8a. What are the different kinds of cement available and what is their use. (5)
- b. List the properties of good building bricks. Explain any five. (5)

OR

- 9a. List and explain any five modern construction materials used for construction. (5)
- b. Explain the objectives and principles of surveying (5)

MODULE III

- 10a. Draw the elevation and plan of one brick thick wall with English bond (5)
- b. Explain the energy systems and water management in Green buildings (5)

OR

- 11a. Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing. (5)
- b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building (5)

[10 x 3 = 30]

PART II: BASIC MECHANICAL ENGINEERING

PART A

Answer all questions. Each question carries 4 marks

1. Sketch the P-v and T-s diagram of a Carnot cycle and List the processes.
2. Illustrate the working of an epicyclic gear train.
3. Explain cooling and dehumidification processes.
4. Differentiate between soldering and brazing.
5. Explain the principle of Additive manufacturing.

4 x 5 = 20 marks

Part B

Answer one full question from each module.

MODULE I

6. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35°C, 0.1MPa. The maximum temperature of the cycle is 1100°C. Find
 - i) Heat supplied per kg of air,
 - ii) Work done per kg of air,
 - iii) Cycle efficiencyTake $C_p = 1.005 \text{ kJ/kgK}$ and $C_v = 0.718 \text{ kJ/kgK}$

10 marks

OR

7.
 - a) Explain the working of a 4 stroke SI engine with neat sketches. 7 marks
 - b) Explain the fuel system of a petrol engine. 3 marks

MODULE II

8.
 - a) Explain the working of a vapour compression system with help of a block diagram. 7 marks
 - b) Define: Specific humidity, relative humidity and dew point temperature. 3 marks

OR

9. With the help of a neat sketch, explain the working of a centrifugal pump. 10 marks

MODULE III

10. Explain the two high, three high, four high and cluster rolling mills with neat sketches. 10 marks

OR

11.
 - a) Describe the arc welding process with a neat sketch. 6 marks
 - b) Differentiate between up-milling and down-milling operations. 4 marks

SYLLABUS

Module 1

General Introduction to Civil Engineering: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment. Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.

Introduction to buildings: Types of buildings, selection of site for buildings, components of a residential building and their functions.

Building rules and regulations: Relevance of NBC, KBR & CRZ norms (brief discussion only).

Building area: Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.

Module 2

Surveying: Importance, objectives and principles.

Construction materials, Conventional construction materials: types, properties and uses of building materials: bricks, stones, cement, sand and timber

Cement concrete: Constituent materials, properties and types.

Steel: Steel sections and steel reinforcements, types and uses.

Modern construction materials:- Architectural glass, ceramics, Plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials. Modern uses of gypsum, pre-fabricated building components (brief discussion only).

Module 3

Building Construction: Foundations: Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Load bearing and framed structures (concept only).

Brick masonry: - Header and stretcher bond, English bond & Flemish bond random rubble masonry.

Roofs and floors: - Functions, types; flooring materials (brief discussion only).

Basic infrastructure services: MEP, HVAC, elevators, escalators and ramps (Civil Engineering aspects only), fire safety for buildings.

Green buildings:- Materials, energy systems, water management and environment for green buildings. (brief discussion only).

Module 4

Analysis of thermodynamic cycles: Carnot, Otto, Diesel cycles, Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency. IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines. Efficiencies of IC Engines(Definitions only), Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines.

Module 5

Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems); Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners. Description about working with sketches of: Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)
Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches.

Module 6

Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.
Metal Joining Processes: List types of welding, Description with sketches of Arc Welding, Soldering and Brazing and their applications
Basic Machining operations: Turning, Drilling, Milling and Grinding.
Description about working with block diagram of: Lathe, Drilling machine, Milling machine, CNC Machine. Principle of CAD/CAM, Rapid and Additive manufacturing.

Text Books:

1. Rangwala, S. C., Essentials of Civil Engineering, Charotar Publishing House
2. McKay, W.B. and McKay, J. K., Building Construction, Volumes 1 to 4, Pearson India Education Services

References Books:

1. Chen W.F and Liew J Y R (Eds), The Civil Engineering Handbook. II Edition CRC Press (Taylor and Francis)
2. Chudley, R and Greeno R, Building construction handbook, Addison Wesley, Longman group, England
3. Chudley, R, Construction Technology, Vol. I to IV, Longman group, England Course Plan
4. Kandya A A, Elements of Civil Engineering, Charotar Publishing house
5. Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, Pearson Publishers
6. Rangwala S.C and Dalal K B Building Construction Charotar Publishing house
7. Clifford, M., Simmons, K. and Shipway, P., An Introduction to Mechanical Engineering Part I - CRC Press
8. Roy and Choudhary, Elements of Mechanical Engineering, Media Promoters & Publishers Pvt. Ltd., Mumbai.
9. Sawhney, G. S., Fundamentals of Mechanical Engineering, PHI
10. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGrawHill Education; First edition, 2018
11. Benjamin, J., Basic Mechanical Engineering, Pentex Books, 9th Edition, 2018
12. Balachandran, P. Basic Mechanical Engineering, Owl Books

Course Contents and Lecture Schedule:

No	Topic	Course outcomes addressed	No. of Lectures
1	Module I		Total: 7
1.1	<i>General Introduction to Civil Engineering:</i> Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment.	CO1	1
1.2	Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.	CO1	2
1.3	<i>Introduction to buildings:</i> Types of buildings, selection of site for buildings, components of a residential building and their functions.	CO2	2
1.4	<i>Building rules and regulations:</i> Relevance of NBC, KBR & CRZ norms (brief discussion only)	CO2	1
1.5	<i>Building area:</i> Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.	CO2	1
2	Module 2		Total: 7
2.1	<i>Surveying:</i> Importance, objectives and principles.	CO3	1
2.2	Bricks: - Classification, properties of good bricks, and tests on bricks	CO2	1
2.3	Stones: - <i>Qualities</i> of good stones, types of stones and their uses. Cement: - Good qualities of cement, types of cement and their uses.	CO2	1
2.4	Sand: - Classification, qualities of good sand and sieve analysis (basics only). Timber: - Characteristics, properties and uses.	CO2	1
2.5	Cement concrete: - Constituent materials, properties and types, Steel: - Steel sections and steel reinforcements, types and uses.	CO2	1

2.6	Modern construction materials: - Architectural glass, ceramics, plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials, modern uses of gypsum, pre-fabricated building components (brief discussion only)	CO2	2
3	Module 3		Total: 7
3.1	Foundations: - Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Brick masonry: - Header and stretcher bond, English bond & Flemish bond– elevation and plan (one & one and a half brick wall only). Random rubble masonry.	CO2	2
3.2	Roofs: Functions, types; roofing materials (brief discussion only) Floors: Functions, types; flooring materials (brief discussion only)	CO2	2
3.3	<i>Basic infrastructure services:</i> MEP, HVAC, Elevators, escalators and ramps (Civil Engineering aspects only) fire safety for buildings	CO4	2
3.4	<i>Green buildings:-</i> Materials, energy systems, water management and environment for green buildings. (brief discussion only)	CO5	1
4	MODULE 4		
4.1	Analysis of thermodynamic cycles: Carnot, Otto, and Diesel cycle- Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency	4	
4.2	IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines, efficiencies of IC Engines(Description only)	2	
4.3	Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines	2	
5	MODULE 5		
5.1	Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems)	1	
5.2	Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.	1	

5.3	Description about working with sketches : Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)	4
5.4	Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches	3
6	MODULE 6	
6.1	Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.	2
6.2	Metal Joining Processes :List types of welding, Description with sketches of Arc Welding, Soldering and Brazing, and their applications	1
6.3	Basic Machining operations: Turning, Drilling, Milling and Grinding Description about working with block diagrams of: Lathe, Drilling machine, Milling machine, CNC Machine	3
6.4	Principle of CAD/CAM, Rapid and Additive manufacturing	1

EST 130	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

This course aims to (1) equip the students with an understanding of the fundamental principles of electrical engineering (2) provide an overview of evolution of electronics, and introduce the working principle and examples of fundamental electronic devices and circuits (3) provide an overview of evolution of communication systems, and introduce the basic concepts in radio communication.

Prerequisite: Physics and Mathematics (Pre-university level)

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits
CO 2	Develop and solve models of magnetic circuits
CO 3	Apply the fundamental laws of electrical engineering to solve simple ac circuits in steady state
CO 4	Describe working of a voltage amplifier
CO 5	Outline the principle of an electronic instrumentation system
CO 6	Explain the principle of radio and cellular communication

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	-	-	-	-	-	-	-	-	-	2
CO 2	3	1	-	-	-	-	-	-	-	-	-	2
CO 3	3	1	-	-	-	-	-	-	-	-	-	2
CO 4	2	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	2
CO 6	2	-	-	-	-	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Basic Electrical Engineering			Basic Electronics Engineering		
	Continuous Assessment Tests		End Semester Examination (Marks)	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)		Test 1 (Marks)	Test 2 (Marks)	
Remember	0	0	10	10	10	20
Understand	12.5	12.5	20	15	15	30
Apply	12.5	12.5	20			
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part I – Basic Electrical Engineering and Part II – Basic Electronics Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts - Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answerbooklets.**

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Solve problems based on current division rule.
2. Solve problems with Mesh/node analysis.
3. Solve problems on Wye-Delta Transformation.

Course Outcome 2 (CO2):

1. Problems on series magnetic circuits
2. Problems on parallel magnetic circuits
3. Problems on composite magnetic circuits

4. Course Outcome 3 (CO3):

1. problems on self inductance, mutual inductance and coefficient of coupling
2. problems on rms and average values of periodic waveforms
3. problems on series ac circuits
4. Compare star and Delta connected 3 phase AC systems.

Course Outcome 4 (CO4): Describe working of a voltage amplifier

1. What is the need of voltage divider biasing in an RC coupled amplifier?

2. Define operating point in the context of a BJT amplifier.
3. Why is it required to have a voltage amplifier in a public address system?

Course Outcome 5 (CO5): Outline the principle of an electronic instrumentation system

1. Draw the block diagram of an electronic instrumentation system.
2. What is a transducer?
3. Explain the working principle of operation of digital multimeter.

Course Outcome 6 (CO6): Explain the principle of radio and cellular communication

1. What is the working principle of an antenna when used in a radio transmitter?
2. What is the need of two separate sections RF section and IF section in a superheterodyne receiver?
3. What is meant by a cell in a cellular communication?

Model Question Paper

QP CODE:

Pages: 3

Reg No.: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: EST 130

Course Name: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Max. Marks: 100

Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

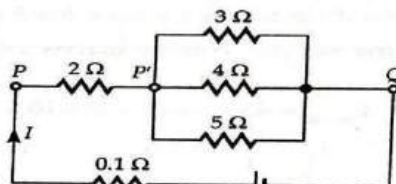
PART I

BASIC ELECTRICAL ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Calculate the current through the 4-ohm resistor in the circuit shown, applying current division rule:



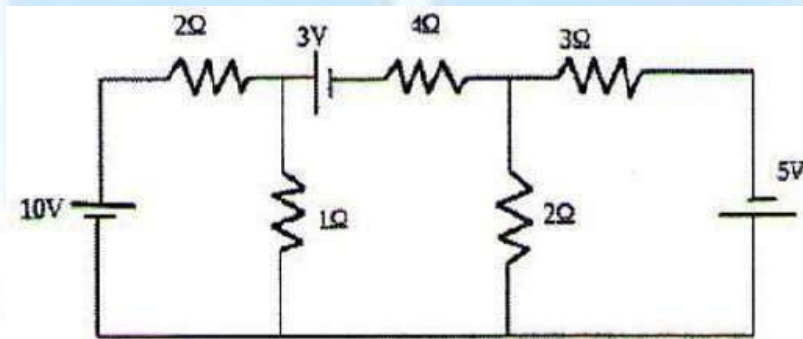
2. Calculate the RMS and average values of a purely sinusoidal current having peak value 15A.
3. An alternating voltage of $(80+j60)V$ is applied to an RX circuit and the current flowing through the circuit is $(-4+j10)A$. Calculate the impedance of the circuit in rectangular and polar forms. Also determine if X is inductive or capacitive.
4. Derive the relation between line and phase values of voltage in a three phase star connected system.
5. Compare electric and magnetic circuits. (5x4=20)

PART B

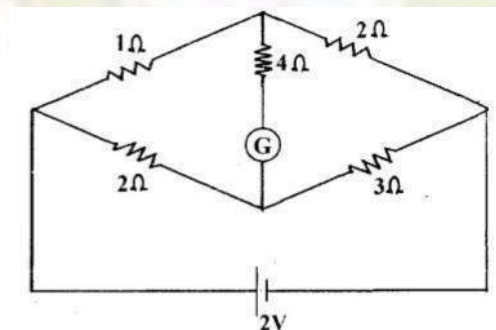
Answer one question from each module; each question carries 10 marks.

Module 1

6. . Calculate the node voltages in the circuit shown, applying node analysis:



7. (a) State and explain Kirchhoff's laws. (4 marks)
- (b) Calculate the current through the galvanometer (G) in the circuit shown:



(6 marks)

Module 2

8. (a) State and explain Faraday's laws of electromagnetic induction with examples. (4 marks)
- (b) Differentiate between statically and dynamically induced emf. A conductor of length 0.5m moves in a uniform magnetic field of flux density 1.1T at a velocity of 30m/s. Calculate the emf induced in the conductor if the direction of motion of the conductor is inclined at 60° to the direction of field. (6marks)
9. (a) Derive the amplitude factor and form factor of a purely sinusoidal waveform. (5 marks)
- (b) A current wave is made up of two components-a 5A dc component and a 50Hz ac component, which is a sinusoidal wave with a peak value of 5A. Sketch the resultant waveform and determine its RMS and average values. (5marks)

Module 3

10. Draw the power triangle and define active, reactive and apparent powers in ac circuits. Two coils A and B are connected in series across a 240V, 50Hz supply. The resistance of A is 5Ω and the inductance of B is 0.015H. If the input from the supply is 3kW and 2kVAR, find the inductance of A and the resistance of B. Also calculate the voltage across each coil.
11. A balanced three phase load consists of three coils each having resistance of 4Ω and inductance 0.02H. It is connected to a 415V, 50Hz, 3-phase ac supply. Determine the phase voltage, phase current, power factor and active power when the loads are connected in (i) star (ii) delta.

(3x10=30)

PART II

BASIC ELECTRONICS ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Give the specifications of a resistor. The colour bands marked on a resistor are Blue, Grey, Yellow and Gold. What are the minimum and maximum resistance values expected from that resistance?
2. What is meant by avalanche breakdown?
3. Explain the working of a full-wave bridge rectifier.
4. Discuss the role of coupling and bypass capacitors in a single stage RC coupled amplifier.
5. Differentiate AM and FM communication systems.

(5x4=20)

PART B

Answer one question from each module; each question carries 10 marks.

Module 4

6. a) Explain with diagram the principle of operation of an NPN transistor. (5)
b) Sketch and explain the typical input-output characteristics of a BJT when connected in common emitter configuration. (5)

OR

7. a) Explain the formation of a potential barrier in a P-N junction diode. (5)
b) What do you understand by Avalanche breakdown? Draw and explain the V-I characteristics of a P-N junction and Zener diode. (5)

Module 5

8. a) With a neat circuit diagram, explain the working of an RC coupled amplifier. (6)
b) Draw the frequency response characteristics of an RC coupled amplifier and state the reasons for the reduction of gain at lower and higher frequencies. (4)

OR

9. a) With the help of block diagram, explain how an electronic instrumentation system. (6)
b) Explain the principle of an antenna. (4)

Module 6

10. a) With the help of a block diagram, explain the working of Super heterodyne receiver. (6)
b) Explain the importance of antenna in a communication system. (4)

OR

11. a) With neat sketches explain a cellular communication system. (5)
b) Explain GSM communication with the help of a block diagram. (5)

(3x10=30)

SYLLABUS

MODULE 1: Elementary Concepts of Electric Circuits

Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.

Analysis of DC electric circuits: Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.

MODULE 2: Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals

Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.

Electromagnetic Induction: Faraday's laws, problems, Lenz's law- statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling

Alternating Current fundamentals: Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.

MODULE 3: AC Circuits

AC Circuits: Phasor representation of sinusoidal quantities. Trigonometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.

Three phase AC systems: Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems

MODULE 4

Introduction to Semiconductor devices: Evolution of electronics – Vacuum tubes to nano electronics. Resistors, Capacitors and Inductors (constructional features not required): types, specifications. Standard values, color coding. PN Junction diode: Principle of operation, V-I characteristics, principle of avalanche breakdown. Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration.

MODULE 5

Basic electronic circuits and instrumentation: Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

MODULE 6

Introduction to Communication Systems: Evolution of communication systems – Telegraphy to 5G. Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge. Mobile communication: basic principles of cellular communications, principle and block diagram of GSM.

Text Books

1. D P Kothari and I J Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D C Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3. ChinmoySaha, Arindham Halder and Debarati Ganguly, Basic Electronics - Principles and Applications, Cambridge University Press, 2018.
4. M.S.Sukhija and T.K.Nagsarkar, Basic Electrical and Electronics Engineering, Oxford University Press, 2012.
5. Wayne Tomasi and Neil Storey, A Textbook On Basic Communication and Information Engineering, Pearson, 2010.

Reference Books

1. Del Toro V, "Electrical Engineering Fundamentals", Pearson Education.
2. T. K. Nagsarkar, M. S. Sukhija, "Basic Electrical Engineering", Oxford Higher Education.
3. Hayt W H, Kemmerly J E, and Durbin S M, "Engineering Circuit Analysis", Tata McGraw-Hill
4. Hughes, "Electrical and Electronic Technology", Pearson Education.
5. V. N. Mittle and Arvind Mittal, "Basic Electrical Engineering," Second Edition, McGraw Hill.
6. Parker and Smith, "Problems in Electrical Engineering", CBS Publishers and Distributors.
7. S. B. Lal Seksena and Kaustuv Dasgupta, "Fundamentals of Electrical Engineering", Cambridge University Press.
8. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.
9. Bernard Grob, Basic Electronics, McGraw Hill.
10. A. Bruce Carlson, Paul B. Crilly, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, Tata McGraw Hill, 5th Edition.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lectures
1	Elementary Concepts of Electric Circuits	
1.1	Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)- problems.	1 2 1
1.2	Analysis of DC electric circuits: Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.	1 1 2
2	Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals	
2.1	Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.	1 2
2.2	Electromagnetic Induction: Faraday's laws, problems, Lenz's law- statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling	1 2
2.3	Alternating Current fundamentals: Generation of alternating voltages- Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.	2
3	AC Circuits	

3.1	AC Circuits: Phasor representation of sinusoidal quantities. Trigonometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power, Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.	1 2 1 2
3.2	Three phase AC systems: Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems.	2
4	Introduction to Semiconductor devices	
4.1	Evolution of electronics – Vacuum tubes to nano electronics (In evolutionary perspective only)	1
4.2	Resistors, Capacitors and Inductors: types, specifications. Standard values, color coding (No constructional features)	2
4.3	PN Junction diode: Principle of operation, V-I characteristics, principle of avalanche breakdown	2
4.4	Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration	3
5	Basic electronic circuits and instrumentation	
5.1	Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator	3
5.2	Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing	4
5.3	Electronic Instrumentation: Block diagram of an electronic instrumentation system	2
6	Introduction to Communication Systems	
6.1	Evolution of communication systems – Telegraphy to 5G	1

6.2	Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge	4
6.3	Mobile communication: basic principles of cellular communications, principle and block diagram of GSM.	2

Suggested Simulation Assignments for Basic Electronics Engineering

1. Plot V-I characteristics of Si and Ge diodes on a simulator
2. Plot Input and Output characteristics of BJT on a simulator
3. Implementation of half wave and full wave rectifiers
4. Simulation of RC coupled amplifier with the design supplied
5. Generation of AM signal

Note: The simulations can be done on open tools such as QUCS, KiCad, GNURadio or similar software to augment the understanding.

EST 102	PROGRAMING IN C	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	2	1	2	4	2019

Preamble: The syllabus is prepared with the view of preparing the Engineering Graduates capable of writing readable C programs to solve computational problems that they may have to solve in their professional life. The course content is decided to cover the essential programming fundamentals which can be taught within the given slots in the curriculum. This course has got 2 Hours per week for practicing programming in C. A list showing 24 mandatory programming problems are given at the end. The instructor is supposed to give homework/assignments to write the listed programs in the rough record as and when the required theory part is covered in the class. The students are expected to come prepared with the required program written in the rough record for the lab classes.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Analyze a computational problem and develop an algorithm/flowchart to find its solution
CO 2	Develop readable* C programs with branching and looping statements, which uses Arithmetic, Logical, Relational or Bitwise operators.
CO 3	Write readable C programs with arrays, structure or union for storing the data to be processed
CO 4	Divide a given computational problem into a number of modules and develop a readable multi-function C program by using recursion if required, to find the solution to the computational problem
CO 5	Write readable C programs which use pointers for array processing and parameter passing
CO 6	Develop readable C programs with files for reading input and storing output
readable* - readability of a program means the following: 1. Logic used is easy to follow 2. Standards to be followed for indentation and formatting 3. Meaningful names are given to variables 4. Concise comments are provided wherever needed	

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓				✓	✓	✓
CO2	✓	✓	✓	✓	✓					✓		✓
CO3	✓	✓	✓	✓	✓					✓		✓
CO4	✓	✓	✓	✓	✓					✓	✓	✓
CO5	✓	✓			✓					✓		✓
CO6	✓	✓			✓					✓		✓

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	10	25
Understand	10	15	25
Apply	20	20	40
Analyse	5	5	10
Evaluate			
Create			

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test 1 (for theory, for 2 hrs) : 20 marks

Continuous Assessment Test 2 (for lab, internal examination, for 2 hrs) : 20 marks

Internal Examination Pattern: There will be two parts; Part A and Part B. Part A contains 5 questions with 2 questions from each module ($2.5 \text{ modules} \times 2 = 5$), having 3 marks for each question. Students should answer all questions. Part B also contains 5 questions with 2 questions from each module ($2.5 \text{ modules} \times 2 = 5$), of which a student should answer any one. The questions should not have sub-divisions and each one carries 7 marks.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Write an algorithm to check whether largest of 3 natural numbers is prime or not. Also, draw a flowchart for solving the same problem.

Course Outcome 2 (CO2): Write an easy to read C program to process a set of n natural numbers and to find the largest even number and smallest odd number from the given set of numbers. The program should not use division and modulus operators.

Course Outcome 3 (CO3): Write an easy to read C program to process the marks obtained by n students of a class and prepare their rank list based on the sum of the marks obtained. There are 3 subjects for which examinations are conducted and the third subject is an elective where a student is allowed to take any one of the two courses offered.

Course Outcome 4 (CO4): Write an easy to read C program to find the value of a mathematical function f which is defined as follows. $f(n) = n! / (\text{sum of factors of } n)$, if n is not prime and $f(n) = n! / (\text{sum of digits of } n)$, if n is prime.

Course Outcome 5 (CO5): Write an easy to read C program to sort a set of n integers and to find the number of unique numbers and the number of repeated numbers in the given set of numbers. Use a function which takes an integer array of n elements, sorts the array using the Bubble Sorting Technique and returns the number of unique numbers and the number of repeated numbers in the given array.

Course Outcome 6 (CO6): Write an easy to read C program to process a text file and to print the Palindrome words into an output file.

Model Question paper

QP CODE:

PAGES:3

Reg No: _____

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: EST 102

Course Name: Programming in C (Common to all programs)

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Write short note on processor and memory in a computer.
2. What are the differences between compiled and interpreted languages? Give example for each.
3. Write a C program to read a Natural Number through keyboard and to display the reverse of the given number. For example, if "3214567" is given as input, the output to be shown is "7654123".
4. Is it advisable to use *goto* statements in a C program? Justify your answer.
5. Explain the different ways in which you can *declare & initialize* a single dimensional array.
6. Write a C program to read a sentence through keyboard and to display the count of white spaces in the given sentence.
7. What are the advantages of using functions in a program?
8. With a simple example program, explain *scope* and *life time* of variables in C.
9. Write a function in C which takes the address of a single dimensional array (containing a finite sequence of numbers) and the number of numbers stored in the array as arguments and stores the numbers in the same array in reverse order. Use pointers to access the elements of the array.
10. With an example, explain the different modes of opening a file. (10x3=30)

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. (a) Draw a flow chart to find the position of an element in a given sequence, using linear searching technique. With an example explain how the flowchart finds the position of a given element. (10)
- (b) Write a pseudo code representing the flowchart for linear searching. (4)

OR

12. (a) With the help of a flow chart, explain the bubble sort operation. Illustrate with an example. (10)
(b) Write an algorithm representing the flowchart for bubble sort. (4)

13. (a) Write a C program to read an English Alphabet through keyboard and display whether the given Alphabet is in upper case or lower case. (6)
(b) Explain how one can use the builtin function in C, *scanf* to read values of different data types. Also explain using examples how one can use the builtin function in C, *printf* for text formatting. (8)

OR

14. (a) With suitable examples, explain various operators in C. (10)
(b) Explain how characters are stored and processed in C. (4)

15. (a) Write a function in C which takes a 2-Dimensional array storing a matrix of numbers and the order of the matrix (number of rows and columns) as arguments and displays the sum of the elements stored in each row. (6)
(b) Write a C program to check whether a given matrix is a diagonal matrix. (8)

OR

16. (a) Without using any builtin string processing function like *strlen*, *strcat* etc., write a program to concatenate two strings. (8)
(b) Write a C program to perform bubble sort. (6)
17. (a) Write a function namely *myFact* in C to find the factorial of a given number. Also, write another function in C namely *nCr* which accepts two positive integer parameters *n* and *r* and returns the value of the mathematical function $C(n,r) = \frac{n!}{r! \times (n-r)!}$. The function *nCr* is expected to make use of the factorial function *myFact*. (10)
(b) What is recursion? Give an example. (4)

OR

18. (a) With a suitable example, explain the differences between a structure and a union in C. (6)
(b) Declare a structure namely *Student* to store the details (*roll number*, *name*, *mark_for_C*) of a student. Then, write a program in C to find the average mark obtained by the students in a class for the subject *Programming in C* (using the field *mark_for_C*). Use array of structures to store the required data. (8)

19. (a) With a suitable example, explain the concept of pass by reference. (6)
(b) With a suitable example, explain how pointers can help in changing the content of a single dimensionally array passed as an argument to a function in C. (8)

OR

20. (a) Differentiate between sequential files and random access files? (4)

(b) Using the prototypes explain the functionality provided by the following functions. (10)

rewind()

i. *fseek()*

ii. *ftell()*

iii. *fread()*

iv. *fwrite()*

(14X5=70)

SYLLABUS

Programming in C (Common to all disciplines)

Module 1

Basics of Computer Hardware and Software

Basics of Computer Architecture: processor, Memory, Input& Output devices

Application Software & System software: Compilers, interpreters, High level and low level languages

Introduction to structured approach to programming, Flow chart Algorithms, Pseudo code (*bubble sort, linear search - algorithms and pseudocode*)

Module 2

Program Basics

Basic structure of C program: Character set, Tokens, Identifiers in C, Variables and Data Types , Constants, Console IO Operations, printf and scanf

Operators and Expressions: Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, size of operator, Assignment operators and Bitwise Operators. Operators Precedence

Control Flow Statements: If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements.(Simple programs covering control flow)

Module 3

Arrays and strings

Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array

String processing: In built String handling functions (strlen, strcpy, strcat and strcmp, puts, gets)

Linear search program, bubble sort program, simple programs covering arrays and strings

Module 4

Working with functions

Introduction to modular programming, writing functions, formal parameters, actual parameters Pass by Value, Recursion, Arrays as Function Parameters structure, union, Storage Classes, Scope and life time of variables, *simple programs using functions*

Module 5

Pointers and Files

Basics of Pointer: declaring pointers, accessing data through pointers, NULL pointer, array access using pointers, pass by reference effect

File Operations: open, close, read, write, append

Sequential access and random access to files: In built file handling functions (*rewind()*, *fseek()*, *ftell()*, *feof()*, *fread()*, *fwrite()*), simple programs covering pointers and files.

Text Books

1. Schaum Series, Gottfried B.S., Tata McGraw Hill, Programming with C
2. E. Balagurusamy, McGraw Hill, Programming in ANSI C
3. Asok N Kamthane, Pearson, Programming in C
4. Anita Goel, Pearson, Computer Fundamentals

Reference Books

1. Anita Goel and Ajay Mittal, Pearson, Computer fundamentals and Programming in C
2. Brian W. Kernighan and Dennis M. Ritchie, Pearson, C Programming Language
3. Rajaraman V, PHI, Computer Basics and Programming in C
4. Yashavant P, Kanetkar, BPB Publications, Let us C

Course Contents and Lecture Schedule

Module 1: Basics of Computer Hardware and Software		(7 hours)
1.1	Basics of Computer Architecture: Processor, Memory, Input & Output devices	2 hours
1.2	Application Software & System software: Compilers, interpreters, High level and low level languages	2 hours
1.3	Introduction to structured approach to programming, Flow chart	1 hours
1.4	Algorithms, Pseudo code (<i>bubble sort, linear search - algorithms and pseudocode</i>)	2 hours
Module 2: Program Basics		(8 hours)
2.1	Basic structure of C program: Character set, Tokens, Identifiers in C, Variables and Data Types, Constants, Console IO Operations, printf and scanf	2 hours
2.2	Operators and Expressions: Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, sizeof operator, Assignment operators and Bitwise Operators. Operators Precedence	2 hours

2.3	Control Flow Statements: If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements. <i>(Simple programs covering control flow)</i>	4 hours
Module 3: Arrays and strings:		(6 hours)
3.1	Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array	2 hours
3.2	String processing: In built String handling functions(<i>strlen, strcpy, strcat and strcmp, puts, gets</i>)	2 hours
3.3	Linear search program, bubble sort program, <i>simple programs covering arrays and strings</i>	3 hours
Module 4: Working with functions		(7 hours)
4.1	Introduction to modular programming, writing functions, formal parameters, actual parameters	2 hours
4.2	Pass by Value, Recursion, Arrays as Function Parameters	2 hours
4.3	structure, union, Storage Classes, Scope and life time of variables, <i>simple programs using functions</i>	3 hours
Module 5: Pointers and Files		(7 hours)
5.1	Basics of Pointer: declaring pointers, accessing data through pointers, NULL pointer, array access using pointers, pass by reference effect	3 hours
5.2	File Operations: open, close, read, write, append	1 hours
5.3	Sequential access and random access to files: In built file handling functions (<i>rewind(), fseek(), ftell(), feof(), fread(), fwrite()</i>), <i>simple programs covering pointers and files.</i>	2 hours

C PROGRAMMING LAB (Practical part of EST 102, Programming in C)

Assessment Method: The Academic Assessment for the Programming lab should be done internally by the College. The assessment shall be made on 50 marks and the mark is divided as follows: Practical Records/Outputs - 20 marks (internal by the College), Regular Lab Viva - 5 marks (internal by the College), Final Practical Exam – 25 marks (internal by the College).

The mark obtained out of 50 will be converted into equivalent proportion out of 20 for CIE computation.

LIST OF LAB EXPERIMENTS

1. Familiarization of Hardware Components of a Computer
2. Familiarization of Linux environment – How to do Programming in C with Linux
3. Familiarization of console I/O and operators in C
 - i) Display “Hello World”
 - ii) Read two numbers, add them and display their sum
 - iii) Read the radius of a circle, calculate its area and display it
 - iv) Evaluate the arithmetic expression $((a - b / c * d + e) * (f + g))$ and display its solution. Read the values of the variables from the user through console.
4. Read 3 integer values and find the largest among them.
5. Read a Natural Number and check whether the number is prime or not
6. Read a Natural Number and check whether the number is Armstrong or not
7. Read n integers, store them in an array and find their sum and average
8. Read n integers, store them in an array and search for an element in the array using an algorithm for Linear Search
9. Read n integers, store them in an array and sort the elements in the array using Bubble Sort algorithm
10. Read a string (word), store it in an array and check whether it is a palindrome word or not.
11. Read two strings (each one ending with a \$ symbol), store them in arrays and concatenate them without using library functions.
12. Read a string (ending with a \$ symbol), store it in an array and count the number of vowels, consonants and spaces in it.
13. Read two input each representing the distances between two points in the Euclidean space, store these in structure variables and add the two distance values.
14. Using structure, read and print data of n employees (*Name, Employee Id and Salary*)
15. Declare a union containing 5 string variables (*Name, House Name, City Name, State and Pin code*) each with a length of C_SIZE (user defined constant). Then, read and display the address of a person using a variable of the union.
16. Find the factorial of a given Natural Number n using recursive and non recursive functions
17. Read a string (word), store it in an array and obtain its reverse by using a user defined function.
18. Write a menu driven program for performing matrix addition, multiplication and finding the transpose. Use functions to (i) read a matrix, (ii) find the sum of two matrices, (iii) find the product of two matrices, (iv) find the transpose of a matrix and (v) display a matrix.
19. Do the following using pointers
 - i) add two numbers
 - ii) swap two numbers using a user defined function
20. Input and Print the elements of an array using pointers
21. Compute sum of the elements stored in an array using pointers and user defined function.
22. Create a file and perform the following
 - iii) Write data to the file
 - iv) Read the data in a given file & display the file content on console
 - v) append new data and display on console
23. Open a text input file and count number of characters, words and lines in it; and store the results in an output file.

CO 7	2											
CO 8	2											

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	70	30	1 hour

Assessment Procedure: Total marks allotted for the course is 100 marks. CIE shall be conducted for 70 marks and ESE for 30 marks. CIE should be done for the work done by the student and also viva voce based on the work done on each practical session. ESE shall be evaluated by written examination of one hour duration conducted internally by the institute.

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

PART 1

CIVIL WORKSHOP

- Exercise 1. Calculate the area of a built-up space and a small parcel of land- Use standard measuring tape and digital distance measuring devices
- Exercise 2. (a) Use screw gauge and vernier calliper to measure the diameter of a steel rod and thickness of a flat bar
- (b) Transfer the level from one point to another using a water level
- (c) Set out a one room building with a given plan and measuring tape
- Exercise 3. Find the level difference between any two points using dumpy level
- Exercise 4. (a) Construct a $1\frac{1}{2}$ thick brick wall of 50 cm height and 60 cm length using English bond. Use spirit level to assess the tilt of walls.
- (b) Estimate the number of different types of building blocks to construct this wall.

- Exercise 5. (a) Introduce the students to plumbing tools, different types of pipes, type of connections, traps, valves, fixtures and sanitary fittings.
- (b) Install a small rainwater harvesting installation in the campus

Reference Books:

1. Khanna P.N, "Indian Practical Civil Engineering Handbook", Engineers Publishers.
2. Bhavikatti. S, "Surveying and Levelling (Volume 1)", I.K. International Publishing House
3. Arora S.P and Bindra S.P, " Building Construction", Dhanpat Rai Publications
4. S. C. Rangwala, "Engineering Materials," Charotar Publishing House.

PART II

MECHANICAL WORKSHOP

LIST OF EXERCISES

(Minimum EIGHT units mandatory and FIVE models from Units 2 to 8 mandatory)

UNIT 1:- General : Introduction to workshop practice, Safety precautions, Shop floor ethics, Basic First Aid knowledge.

Study of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc.

UNIT 2:- Carpentry : Understanding of carpentry tools

Minimum any one model

1. T-Lap joint
2. Cross lap joint
3. Dovetail joint
4. Mortise joints

UNIT 3:- Foundry : Understanding of foundry tools

Minimum any one model

1. Bench Molding
2. Floor Molding
3. Core making
4. Pattern making

UNIT 4: - Sheet Metal : Understanding of sheet metal working tools

Minimum any one model

1. Cylindrical shape
2. Conical shape
3. Prismatic shaped job from sheet metal

UNIT 5: - Fitting : Understanding of tools used for fitting

Minimum any one model

1. Square Joint
2. V-Joint
3. Male and female fitting

UNIT 6: - Plumbing : Understanding of plumbing tools, pipe joints

Any one exercise on joining of pipes making use of minimum three types of pipe joints

UNIT 7: - Smithy: Understanding of tools used for smithy.

Demonstrating the forge-ability of different materials (MS, Al, alloy steel and cast steels) in cold and hot states.

Observing the qualitative difference in the hardness of these materials

Minimum any one exercise on smithy

1. Square prism
2. Hexagonal headed bolt
3. Hexagonal prism
4. Octagonal prism

UNIT 8: -Welding: Understanding of welding equipments

Minimum any one welding practice

Making Joints using electric arc welding. bead formation in horizontal, vertical and over head positions

UNIT 9: - Assembly: Demonstration only

Disassembling and assembling of

1. Cylinder and piston assembly
2. Tail stock assembly
3. Bicycle
4. Pump or any other machine

UNIT 10: - Machines: Demonstration and applications of the following machines

Shaping and slotting machine; Milling machine; Grinding Machine; Lathe; Drilling Machine.

UNIT 11: - Modern manufacturing methods: Power tools, CNC machine tools, 3D printing, Glass cutting.

Course Contents and Lecture Schedule:

No	Topic	No of Sessions
1	INTRODUCTION	
1.1	Workshop practice, shop floor precautions, ethics and First Aid knowledge. Studies of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc	1
2	CARPENTRY	
2.1	Understanding of carpentry tools and making minimum one model	2

3	FOUNDRY	
3.1	Understanding of foundry tools and making minimum one model	2
4	SHEET METAL	
4.1	Understanding of sheet metal working tools and making minimum one model	2
5	FITTING	
5.1	Understanding of fitting tools and making minimum one model	2
6	PLUMBING	
6.1	Understanding of pipe joints and plumbing tools and making minimum one model	2
7	SMITHY	
7.1	Understanding of smithy tools and making minimum one model	2
8	WELDING	
8.1	Understanding of welding equipments and making minimum one model	2
9	ASSEMBLY	
9.1	Demonstration of assembly and disassembling of multiple parts components	1
10	MACHINES	
10.1	Demonstration of various machines	1
11	MODERN MANUFACTURING METHODS	
11.1	Demonstrations of: power tools, CNC Machine tools, 3D printing, Glass cutting	1

MAT 102	VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND TRANSFORMS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: This course introduces the concepts and applications of differentiation and integration of vector valued functions, differential equations, Laplace and Fourier Transforms. The objective of this course is to familiarize the prospective engineers with some advanced concepts and methods in Mathematics which include the Calculus of vector valued functions, ordinary differential equations and basic transforms such as Laplace and Fourier Transforms which are invaluable for any engineer's mathematical tool box. The topics treated in this course have applications in all branches of engineering.

Prerequisite: Calculus of single and multi variable functions.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the derivatives and line integrals of vector functions and learn their applications
CO 2	Evaluate surface and volume integrals and learn their inter-relations and applications.
CO 3	Solve homogeneous and non-homogeneous linear differential equation with constant coefficients
CO 4	Compute Laplace transform and apply them to solve ODEs arising in engineering
CO 5	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	1			1	2		2
CO 2	3	3	3	3	2	1			1	2		2
CO 3	3	3	3	3	2	1			1	2		2
CO 4	3	3	3	3	2	1			1	2		2
CO 5	3	3	3	3	2	1			1	2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			

Create			
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Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

Assignments: Assignment should include specific problems highlighting the applications of the methods introduced in this course in science and engineering.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Compute the derivatives and line integrals of vector functions and learn their applications

1. How would you calculate the speed, velocity and acceleration at any instant of a particle moving in space whose position vector at time t is $\mathbf{r}(t)$?
2. Find the work done by the force field $\mathbf{F} = (e^x - y^3)\mathbf{i} + (\cos y + x^3)\mathbf{j}$ on a particle that travels once around the unit circle centred at origin having radius 1.
3. When do you say that a vector field is conservative? What are the implications if a vector field is conservative?

Course Outcome 2 (CO2): Evaluate surface and volume integrals and learn their inter-relations and applications

1. Write any one application each of line integral, double integral and surface integral.
2. Use the divergence theorem to find the outward flux of the vector field $\mathbf{F}(x, y, z) = z\mathbf{k}$ across the

$$x^2 + y^2 + z^2 = a^2$$

3. State Greens theorem. Use Green's theorem to express the area of a plane region bounded by a curve as a line integral.

Course Outcome 3 (CO3): Solve homogeneous and non-homogeneous linear differential equation with constant coefficients

1. If $y_1(x)$ and $y_2(x)$ are solutions of $y'' + py' + qy = 0$, where p, q are constants, show that

$y_1(x) + y_2(x)$ is also a solution.

2. Solve the differential equation $y'' + y = 0.001x^2$ using method of undetermined coefficient.

3. Solve the differential equation of $y''' - 3y'' + 3y' - y = e^x - x - 1$.

Course Outcome 4 (CO4): Compute Laplace transform and apply them to solve ODEs arising in engineering

1. What is the inverse Laplace Transform of $(s) = \frac{3s-137}{s^2+2s+4}$?

2. Find Laplace Transform of Unit step function.

3. Solve the differential equation of $y + 9y = \delta(t - \frac{\pi}{2})$? Given $y(0) = 2, y'(0) = 0$

Course Outcome 5 (CO5): Determine the Fourier transforms of functions and apply them to solve problems arising in engineering

1. Find the Fourier integral representation of function defined by

$f(x) = e^{-x}$ for $x > 0$ and $f(x) = 0$ for $x < 0$.

2. What are the conditions for the existence of Fourier Transform of a function $f(x)$?

3. Find the Fourier transform of $f(x) = 1$ for $|x| < 1$ and $f(x) = 0$ otherwise.

Model Question paper

QP CODE:

PAGES:3

Reg No: _____

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: MAT 102

Max. Marks: 100

Duration: 3 Hours

VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND TRANSFORMS

(2019-Scheme) (Common

to all branches)

PART A

(Answer all questions. Each question carries 3 marks)

1. Is the vector $\mathbf{r}$ where $\mathbf{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ conservative. Justify your answer.
2. State Greens theorem including all the required hypotheses
3. What is the outward flux of $\mathbf{F}(x, y, z) = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ across any unit cube.
4. What is the relationship between Green's theorem and Stokes theorem?
5. Solve $y'' + 4y' + 2.5y = 0$
6. Does the function $y = C_1 \cos x + C_2 \sin x$ form a solution of $y'' + y = 0$? Is it the general solution? Justify your answer.
7. Find the Laplace transform of $e^{-t} \sinh 4t$
8. Find the Laplace inverse transform of $\frac{1}{s^2 + \omega^2}$
9. Given the Fourier transform $\frac{1}{\sqrt{2\pi}} of $f(x) = e^{-x}$, find the Fourier transform of $xe^{-x}$$
10. State the convolution theorem for Fourier transform

PART B

(Answer one full question from each module. Each full question carries 14 marks)

MODULE 1

11a) Prove that the force field $\mathbf{F} = e^y\mathbf{i} + xe^y\mathbf{j}$ is conservative in the entire xy-plane

b) Use Greens theorem to find the area enclosed by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

12 a) Find the divergence of the vector field $\mathbf{F} = \frac{1}{(x^2 + y^2 + z^2)^{3/2}}(x\mathbf{i} + y\mathbf{j} + z\mathbf{k})$

b) Find the work done by the force field $\mathbf{F}(x, y, z) = xy\mathbf{i} + yz\mathbf{j} + xz\mathbf{k}$ along C where

C is the curve $\mathbf{r}(t) = t\mathbf{i} + t^2\mathbf{j} + t^3\mathbf{k}$

MODULE II

13 a) Use divergence theorem to find the outward flux of the vector field

$\mathbf{F} = 2x\mathbf{i} + 3y\mathbf{j} + z^3\mathbf{k}$ across the unit cube bounded by $x = 0, y = 0, z = 0, x = 1, y = 1, z = 1$

b) Find the circulation of $\mathbf{F} = (x - z)\mathbf{i} + (y - x)\mathbf{j} + (z - xy)\mathbf{k}$ using Stokes theorem around the triangle with vertices $A(1,0,0), B(0,2,0)$ and $C(0,0,1)$

14 a) Use divergence theorem to find the volume of the cylindrical solid bounded by $x^2 + 4x + y^2 = 7, z = -1, z = 4$, given the vector field $\mathbf{F} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ across surface of the cylinder

b) Use Stokes theorem to evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F} = x^2\mathbf{i} + 3x\mathbf{j} - y^3\mathbf{k}$ where C is

the circle $x^2 + y^2 = 1$ in the xy - plane with counterclockwise orientation looking down the positive z -axis

MODULE III

- 15 a) Solve $y'' + 4y' + 4y = x^2 + e^{-x} \cos x$
 b) Solve $y''' - 3y'' + 3y' - y = e^x - x - 1$
 16 a) Solve $y''' + 3y'' + 3y' + y = 30e^{-x}$ given $y(0) = 3, y'(0) = -3, y''(0) = -47$
 b) Using method of variation of parameters, solve $y'' + y = \sec x$

MODULE IV

- 17 a) Find the inverse Laplace transform of $F(s) = \frac{2(e^{-s} - e^{-3s})s^2}{4}$
 b) Solve the differential equation $y'' + 16y = 4\delta(t - 3\pi); y(0) = 2, y'(0) = 0$ using Laplace transform
 18 a) Solve $y'' + 3y' + 2y = f(t)$ where $f(t) = 1$ for $0 < t < 1$ and $f(t) = 1$ for $t > 1$ using Laplace transform
 b) Apply convolution theorem to find the Laplace inverse transform of $\frac{1}{s^2(s^2 + \omega^2)}$

MODULE V

- 19 a) Find the Fourier cosine integral representation for $f(x) = e^{-kx}$ for $x > 0$ and $k > 0$ and hence evaluate $\int_0^\infty \frac{\cos wx}{k^2 + w^2} dw$ the function
 b) Does the Fourier sine transform $f(x) = x^{-1} \sin x$ for $0 < x < \infty$ exist? Justify your answer
 20 a) Find the Fourier transform of $f(x) = |x|$ for $|x| < 1$ and $f(x) = 0$ otherwise
 b) Find the Fourier cosine transform of $f(x) = e^{-ax}$ for $a > 0$

Syllabus

Module 1 (Calculus of vector functions)

(Text 1: Relevant topics from sections 12.1, 12.2, 12.6, 13.6, 15.1, 15.2, 15.3)

Vector valued function of single variable, derivative of vector function and geometrical interpretation, motion along a curve-velocity, speed and acceleration. Concept of scalar and vector fields, Gradient and its properties, directional derivative, divergence and curl, Line integrals of vector fields, work as line integral, Conservative vector fields, independence of path and potential function (results without proof).

Module 2 (Vector integral theorems)

(Text 1: Relevant topics from sections 15.4, 15.5, 15.6, 15.7, 15.8)

Green's theorem (for simply connected domains, without proof) and applications to evaluating line integrals and finding areas. Surface integrals over surfaces of the form $z = g(x, y)$, $y = g(x, z)$ or $x = g(y, z)$, Flux integrals over surfaces of the form $z = g(x, y)$, $y = g(x, z)$ or $x = g(y, z)$, divergence theorem (without proof) and its applications to finding flux integrals, Stokes' theorem (without proof) and its applications to finding line integrals of vector fields and work done.

Module- 3 (Ordinary differential equations)

(Text 2: Relevant topics from sections 2.1, 2.2, 2.5, 2.6, 2.7, 2.10, 3.1, 3.2, 3.3)

Homogenous linear differential equation of second order, superposition principle, general solution, homogenous linear ODEs with constant coefficients-general solution. Solution of Euler-Cauchy equations (second order only). Existence and uniqueness (without proof). Non homogenous linear ODEs-general solution, solution by the method of undetermined coefficients (for the right hand side of the form $x^n, e^{kx}, \sin ax, \cos ax, e^{kx} \sin ax, e^{kx} \cos ax$ and their linear combinations), methods of variation of parameters. Solution of higher order equations-homogeneous and non-homogeneous with constant coefficient using method of undetermined coefficient.

Module- 4 (Laplace transforms)

(Text 2: Relevant topics from sections 6.1, 6.2, 6.3, 6.4, 6.5)

Laplace Transform and its inverse, Existence theorem (without proof), linearity, Laplace transform of basic functions, first shifting theorem, Laplace transform of derivatives and integrals, solution of differential equations using Laplace transform, Unit step function, Second shifting theorems. Dirac delta function and its Laplace transform, Solution of ordinary differential equation involving unit step function and Dirac delta functions. Convolution theorem (without proof) and its application to finding inverse Laplace transform of products of functions.

Module-5 (Fourier Transforms)

(Text 2: Relevant topics from sections 11.7,11.8, 11.9)

Fourier integral representation, Fourier sine and cosine integrals. Fourier sine and cosine transforms, inverse sine and cosine transform. Fourier transform and inverse Fourier transform, basic properties. The Fourier transform of derivatives. Convolution theorem (without proof)

Text Books

1. H. Anton, I. Biven S.Davis, "Calculus", Wiley, 10th edition, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley, 10th edition, 2015.

Reference Books

1. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3. Peter O Neil, Advanced Engineering Mathematics, 7th Edition, Thomson, 2007.
4. Louis C Barret, C Ray Wylie, "Advanced Engineering Mathematics", Tata McGraw Hill, 6th edition, 2003.
5. VeerarajanT."Engineering Mathematics for first year", Tata McGraw - Hill, 2008.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th edition , 2010.
7. Srimanta Pal, Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, 2015.
8. Ronald N. Bracewell, "The Fourier Transform and its Applications", McGraw –Hill International Editions, 2000.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Calculus of vector functions (9 hours)	
1.1	Vector valued function of a scalar variable - derivative of vector valued function of scalar variable t-geometrical meaning	2
1.2	Motion along a curve-speed , velocity, acceleration	1
1.3	Gradient and its properties, directional derivative , divergent and curl	3
1.4	Line integrals with respect to arc length, line integrals of vector fields. Work done as line integral	2
1.5	Conservative vector field, independence of path, potential function	1

2	Vector integral theorems(9 hours)	
2.1	Green's theorem and it's applications	2
2.2	Surface integrals , flux integral and their evaluation	3
2.3	Divergence theorem and applications	2
2.4	Stokes theorem and applications	2
3	Ordinary Differential Equations (9 hours)	
3.1	Homogenous linear equation of second order, Superposition principle, general solution	1
3.2	Homogenous linear ODEs of second order with constant coefficients	2
3.3	Second order Euler-Cauchy equation	1
3.4	Non homogenous linear differential equations of second order with constant coefficient-solution by undetermined coefficients, variation of parameters.	3
3.5	Higher order equations with constant coefficients	2
4	Laplace Transform (10 hours)	
4.1	Laplace Transform , inverse Transform, Linearity, First shifting theorem, transform of basic functions	2
4.2	Transform of derivatives and integrals	1
4.3	Solution of Differential equations, Initial value problems by Laplace transform method.	2
4.4	Unit step function --- Second shifting theorem	2
4.5	Dirac Delta function and solution of ODE involving Dirac delta function	2
4.6	Convolution and related problems.	1
5	Fourier Transform (8 hours)	
5.1	Fourier integral representation	1
5.2	Fourier Cosine and Sine integrals and transforms	2
5.3	Complex Fourier integral representation, Fourier transform and its inverse transforms, basic properties	3
5.4	Fourier transform of derivatives, Convolution theorem	2

ESL 130	ELECTRICAL & ELECTRONICS WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	0	0	2	1	2019

Preamble: Electrical Workshop is intended to impart skills to plan and carry out simple electrical wiring. It is essential for the practicing engineers to identify the basic practices and safety measures in electrical wiring.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Demonstrate safety measures against electric shocks.
CO 2	Identify the tools used for electrical wiring, electrical accessories, wires, cables, batteries and standard symbols
CO 3	Develop the connection diagram, identify the suitable accessories and materials necessary for wiring simple lighting circuits for domestic buildings
CO 4	Identify and test various electronic components
CO 5	Draw circuit schematics with EDA tools
CO 6	Assemble and test electronic circuits on boards
CO 7	Work in a team with good interpersonal skills

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	3	-	-	-	-	-	1
CO 2	2	-	-	-	-	-	-	-	-	1	-	-
CO 3	2	-	-	1	-	1	-	1	2	2	-	2
CO 4	3	-	-	-	-	-	-	-	-	-	-	2
CO 5	3	-	-	-	2	-	-	-	-	-	-	2
CO 6	3	-	-	-	2	-	-	-	-	-	-	1
CO 7	-	-	-	-	-	-	-	-	3	2	-	2

Mark distribution

Total Marks	CIE	ESE	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

Syllabus**PART 1****ELECTRICAL****List of Exercises / Experiments**

1. a) Demonstrate the precautionary steps adopted in case of Electrical shocks.
b) Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB with ratings.
2. Wiring of simple light circuit for controlling light/ fan point (PVC conduit wiring)
3. Wiring of light/fan circuit using Two way switches . (Staircase wiring)
4. Wiring of Fluorescent lamps and light sockets (6A) with a power circuit for controlling power device. (16A socket)
5. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
6. a) Identify different types of batteries with their specifications.
b) Demonstrate the Pipe and Plate Earthing Schemes using Charts/Site Visit.

PART II**ELECTRONICS****List of Exercises / Experiments (Minimum of 7 mandatory)**

1. Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.]

2. Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools (such as Dia or Xcircuit), Interpret data sheets of discrete components and IC's, Estimation and costing.
3. Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, DSO etc.] [Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de-soldering station etc.]
4. Testing of electronic components [Resistor, Capacitor, Diode, Transistor and JFET using multimeter.]
5. Inter-connection methods and soldering practice. [Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions, soldering practice in connectors and general purpose PCB, Crimping.]
6. Printed circuit boards (PCB) [Types, Single sided, Double sided, PTH, Processing methods, Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.]
7. Assembling of electronic circuits using SMT (Surface Mount Technology) stations.
8. Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (**Any Two circuits**).
 1. Fixed voltage power supply with transformer, rectifier diode, capacitor filter, zener/IC regulator.
 2. Square wave generation using IC 555 timer in IC base.
 3. Sine wave generation using IC 741 OP-AMP in IC base.
 4. RC coupled amplifier with transistor BC107.

EST 100	ENGINEERING MECHANICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	1	0	3	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of mechanics and enhance their problem-solving skills. It introduces students to the influence of applied force system and the geometrical properties of the rigid bodies while stationary or in motion. After this course students will be able to recognize similar problems in real-world situations and respond accordingly.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able to:

CO 1	Recall principles and theorems related to rigid body mechanics
CO 2	Identify and describe the components of system of forces acting on the rigid body
CO 3	Apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	Choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	Solve problems involving rigid bodies, applying the properties of distributed areas and masses

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	15
Understand	10	10	15
Apply	30	30	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions:

Part A

Course Outcome 1 (CO1): (One question from each module to meet the course objective 1: *To recall principles and theorems related to rigid body mechanics*)

1. Explain D'Alembert's principle
2. Distinguish static and dynamic friction
3. State and explain perpendicular axis theorem

Course Outcome 2 (CO2) (One question from each module to meet the course objective 2: *To identify and describe the components of system of forces acting on the rigid body*)

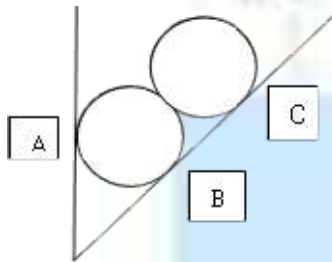
1. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.
2. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar
3. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

Part B

All the questions under this section shall assess the learning levels corresponding to the course outcomes listed below.

CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses

1. Two rollers each of weight 100 N are supported by an inclined plane and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth.

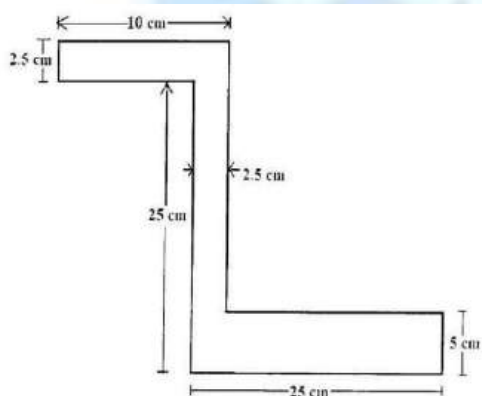


Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent equilibrium state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

2. A cylindrical disc, 50 cm diameter and cm thickness, is in contact with a horizontal conveyor belts running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s. Also compute the moment acting about the axis of the disc in both cases.

Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

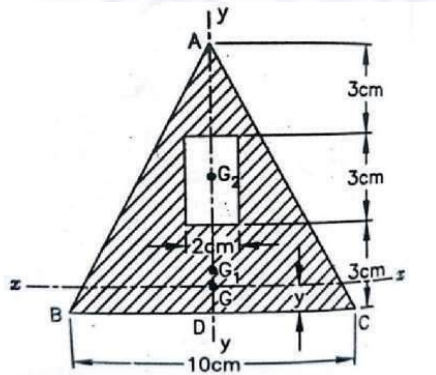
3. Determine the centroid of the given section



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of centroid for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed	Applying (Solve the problem based on the descriptions	6

	areas and masses	given in CO3 and CO4)	
Total			14

4. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC.



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of moment of inertia for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

Model Question Paper

QP CODE:

Reg No.: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

**Course Code: EST 100
ENGINEERING MECHANICS**

Max. Marks: 100

Duration: 3 hours

Part A

(Answer all questions; each question carries 3 marks)

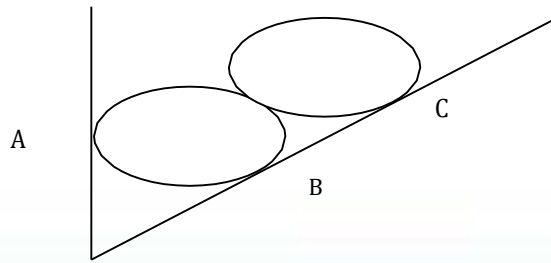
1. Explain D'Alembert's principle
2. Distinguish static and dynamic friction.
3. State and explain perpendicular axis theorem.
4. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.
5. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar
6. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?
7. Compare damped and undamped free vibrations.
8. State the equation of motion of a rotating rigid body, rotating about its fixed axis.
9. Illustrate the significance of instantaneous centre in the analysis of rigid body undergoing rotational motion.
10. Highlight the principles of mechanics applied in the evaluation of elastic collision of rigid bodies.

PART B

(Answer **one full** question from each module, each question carries **14** marks)

Module -I

11. Two identical rollers each of weight 100 N are supported by an inclined plane, making an angle of 30° with the vertical, and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth. (14 marks)

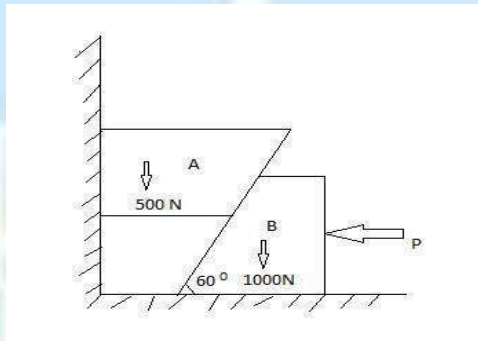


12. A string tied to a wall is made to pass over a pulley placed 2m away from it. A weight P is attached to the string such that the string stretches by 2m from the support on the wall to the location of attachment of weight. Determine the force P required to maintain 200 kg body in position for $\neq 30^\circ$, The diameter of pulley B is negligible. (14 marks)

Module – 2

13. Two blocks A & B are resting against a wall and the floor as shown in figure below. Find the value of horizontal force P applied to the lower block that will hold the system in equilibrium. Coefficient of friction are : 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks.

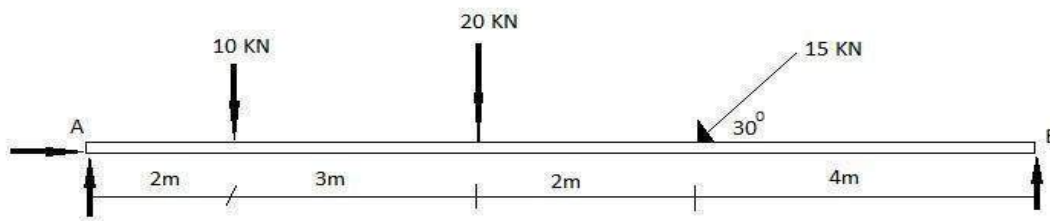
(14 marks)



14. A beam is hinged at A and roller supported at B. It is acted upon by loads as shown below.

Find the reactions at A & B.

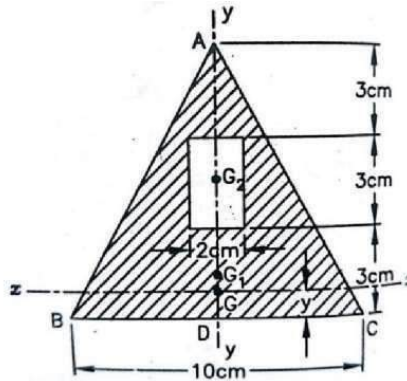
(14 marks)



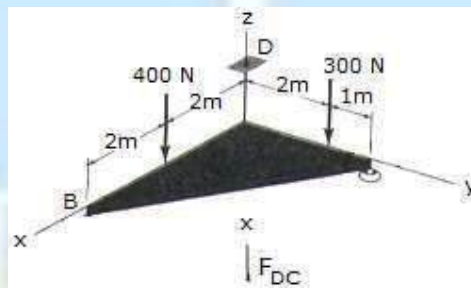
Module – 3

15. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC.

(14 marks)



16. Support A has ball and socket connection. Roller support at B prevents motion in the $-z$ direction. Corner C is tied to D by a rope. The triangle is weightless. Determine the unknown force components acting at A, B, and C. (14 marks)



Module - 4

17. A cricket ball is thrown by a fielder from a height of 2m at an angle of 30° to the horizontal with an initial velocity of 20 m/s, hits the wickets at a height of 0.5 m from the ground. How far was the fielder from the wicket? (14 marks)
18. An engine of weight 500 kN pull a train weighing 1500 kN up an incline of 1 in 100. The train starts from rest and moves with constant acceleration against a resistance of 5 N/kN. It attains a maximum speed of 36 kmph in 1 km distance. Determine the tension in the coupling between train and engine and the traction force developed by the engine. (14marks)

Module - 5

19. A cylindrical disc, 50 cm diameter and 10 cm thickness having mass of 10 kg, is in contact with a horizontal conveyor belt running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s in 10 seconds. Also compute the moment acting about the axis of the disc in both cases. (14 marks)
20. A wheel rotating about fixed axis at 20 rpm is uniformly accelerated for 70 seconds during which time it makes 50 revolutions. Find the (i) angular velocity at the end of this interval and (ii) time required for the velocity to reach 100 revolutions per minute. (14 marks)

SYLLABUS

Module 1

Introduction to Engineering Mechanics-statics-basic principles of statics-Parallelogram law, equilibrium law, principles of superposition and transmissibility, law of action and reaction(review) free body diagrams.

Concurrent coplanar forces-composition and resolution of forces-resultant and equilibrium equations – methods of projections – methods of moments – Varignon's Theorem of moments.

Module 2

Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –wedges, ladder-analysis of connected bodies .

Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads. General coplanar force system - resultant and equilibrium equations.

Module 3

Centroid of composite areas- – moment of inertia-parallel axis and perpendicular axis theorems.

Polar moment of inertia, radius of gyration, mass moment of inertia-ring, cylinder and disc.

Theorem of Pappus Guldinus(demonstration only)

Forces in space - vectorial representation of forces, moments and couples –resultant and equilibrium equations – concurrent forces in space (simple problems only)

Module 4

Dynamics – rectilinear translation - equations of kinematics(review)

kinetics – equation of motion – D'Alembert's principle. – motion on horizontal and inclined surfaces, motion of connected bodies. Impulse momentum equation and work energy equation (concepts only).

Curvilinear translation - equations of kinematics –projectile motion(review), kinetics – equation of motion. Moment of momentum and work energy equation (concepts only).

Module 5

Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – rotation under a constant moment.

Plane motion of rigid body – instantaneous centre of rotation (concept only).

Simple harmonic motion – free vibration –degree of freedom- undamped free vibration of spring mass system-effect of damping(concept only)

Text Books

1. Timoshenko and Young, Engineering Mechanics, McGraw Hill Publishers
2. Shames, I. H., Engineering Mechanics - Statics and Dynamics, Prentice Hall of India.
3. R. C. Hibbeler and Ashok Gupta, Engineering Mechanics, Vol. I statics, Vol II Dynamics, Pearson Education.

References

1. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.
2. Tayal A K, Engineering Mechanics – Statics and Dynamics, Umesh Publications
3. Bhavikkatti, S.S., Engineering Mechanics, New Age International Publishers
4. F.P.Beer and E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I-Statics, Vol.II-Dynamics, 9th Ed, Tata McGraw Hill
5. Rajasekaran S and Sankarasubramanian G, Engineering Mechanics - Statics and Dynamics, Vikas Publishing House Pvt Ltd.

Course Contents and Lecture Schedule:

Module	Topic	Course outcomes addressed	No. of Hours
1	Module 1		Total: 7
1.1	Introduction to engineering mechanics – introduction on statics and dynamics - Basic principles of statics – Parellogram law, equilibrium law – Superposition and transmissibility, law of action and reaction (review the topics)	CO1 and CO2	1
1.2	Free body diagrams. Degree of freedom-types of supports and nature of reactions - exercises for free body diagram preparation – composition and resolution of forces, resultant and equilibrium equations (review the topics) - numerical exercises for illustration.	CO1 and CO2	1
1.3	Concurrent coplanar forces - analysis of concurrent forces -methods of projections – illustrative numerical exercise – teacher assisted problem solving.	CO1 and CO2	1
1.4	Analysis of concurrent forces -methods of moment-Varignon's Theorem of Moments - illustrative numerical exercise– teacher assisted problem solving.	CO1 and CO2	1
1.5	Analysis of concurrent force systems – extended problem solving - Session I.	CO3,CO4 and CO5	1
1.6	Analysis of concurrent force systems – extended problem solving - Session II – learning review quiz.	CO3,CO4 and CO5	1
1.7	Analysis of concurrent force systems – extended problem solving - Session III.	CO3,CO4 and CO5	1
2	Module 2		Total: 7
2.1	Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –illustrative examples on wedges and ladder-teacher	CO1 and CO2	1

	assisted problem solving tutorials using problems from wedges and ladder.		
2.2	Problems on friction - analysis of connected bodies. illustrative numerical exercise– teacher assisted problem solving.	CO3, CO4 and CO5	1
2.3	Problems on friction-extended problem solving	CO3,CO4 and CO5	1
2.4	Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads.	CO1 and CO2	1
2.5	General coplanar force system - resultant and equilibrium equations - illustrative examples- teacher assisted problem solving.	CO1 and CO2	1
2.6	General coplanar force system-resultant and equilibrium equations - illustrative examples	CO3, CO4 and CO5	1
2.7	General coplanar force system - Extended problem solving - Quiz to evaluate learning level.	CO3, CO4 and CO5	1
3	Module 3		Total: 7
3.1	Centroid of simple and regular geometrical shapes – centroid of figures in combination - composite areas- examples for illustration – problems for practice to be done by self.	CO1 and CO2	1
3.2	Moment of inertia- parallel axis theorem –examples for illustration - problems for practice to be done by self.	CO1 and CO2	1
3.3	Moment of inertia - perpendicular axis theorem - example for illustration to be given as hand out and discussion on the solved example.	CO1 and CO2	1
3.4	Solutions to practice problems – problems related to centroid and moment of inertia - problems for practice to be done by self.	CO3, CO4 and CO5	1
3.5	Polar moment of inertia, Radius of gyration. Mass moment of inertia of ring, cylinder and uniform disc. Theorem of Pappus Guldinus - Demonstration	CO1 and CO2	1
3.6	Introduction to forces in space – vectorial representation of forces, moments and couples – simple problems to illustrate vector representations of forces, moments and couples to be done in class.	CO1,and CO2	1
3.7	Solution to practice problems - resultant and equilibrium equations for concurrent forces in space – concurrent forces in space - 2 simple problems to illustrate the application of resultant and equilibrium equations for concurrent forces in space.	CO3,CO4 and CO5	1
4	Module 4		Total: 7

4.1	Introduction to dynamics – review of rectilinear translation - equations of kinematics – problems to review the concepts – additional problems involving extended application as exercises .	CO1 and CO2	1
4.2	Solutions to exercises with necessary explanation given as hand out – introduction to kinetics – equation of motion – D’Alembert’s principle – illustration of the concepts using one numerical exercise from motion on horizontal and inclined surfaces.	CO1 and CO2	1
4.3	Motion of connected bodies - example for illustration to be given as hand out and discussion on the solved example – problems for practice to be done by self.	CO3, CO4 and CO5	1
4.4	Motion of connected bodies-extended problem solving.	CO3, CO4 & CO5	1
4.5	Curvilinear translation - Review of kinematics –projectile motion – simple problems to review the concepts – introduction to kinetics – equation of motion – illustration of the concepts using numerical exercises.	CO3, CO4 & CO5	1
4.6	Extended problem solving – rectilinear and curvilinear translation.	CO3, CO4 & CO5	1
4.7	Concepts on Impulse momentum equation and work energy equation (rectilinear translation – discussions to bring out difference between elastic and inelastic collisions). Concepts on Moment of momentum and work energy equation (curvilinear translation).	CO1 and CO2	1
5	Module 5		Total: 7
5.1	Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – simple problems for illustration.	CO1 and CO2	1
5.2	Rotation under a constant moment – teacher assisted problem solving.	CO3,CO4 and CO5	1
5.3	Rotation under a constant moment - extended problem solving.	CO3, CO4 and CO5	1
5.4	Plane motion of rigid body- instantaneous centre of rotation (concept only).	CO1 and CO2	1
5.5	Introduction to harmonic oscillation –free vibrations - simple harmonic motion – differential equation and solution. Degree of freedom – examples of single degree of freedom (SDOF) systems – Idealisation of mechanical systems as spring-mass systems (concept only).	CO1 and CO2	1

5.6	SDOF spring mass system –equation of motion – undamped free vibration response - concept of natural frequency. Free vibration response due to initial conditions. Simple problems on determination of natural frequency and free vibration response to test the understanding level.	CO1 and CO2	1
5.7	Free vibration analysis of SDOF spring-mass systems – Problem solving Effect of damping on free vibration response (concept only).	CO1and CO2	1



CYT 100	ENGINEERING CHEMISTRY	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like spectroscopy, electrochemistry, instrumental methods etc. Also familiarize the students with topics like mechanism of corrosion, corrosion prevention methods, SEM, stereochemistry, polymers, desalination etc., which enable them to develop abilities and skills that are relevant to the study and practice of chemistry.

Prerequisite: Concepts of chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Apply the basic concepts of electrochemistry and corrosion to explore its possible applications in various engineering fields.
CO 2	Understand various spectroscopic techniques like UV-Visible, IR, NMR and its applications.
CO 3	Apply the knowledge of analytical method for characterizing a chemical mixture or a compound. Understand the basic concept of SEM for surface characterisation of nanomaterials.
CO 4	Learn about the basics of stereochemistry and its application. Apply the knowledge of conducting polymers and advanced polymers in engineering.
CO 5	Study various types of water treatment methods to develop skills for treating wastewater.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	1									
CO 2	1	1		1	2							
CO 3	1	1		1	2							
CO 4	2	1										
CO 5	1			1			3					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			
Create			

End Semester Examination Pattern: There will be two parts- **Part A** and **Part B**. **Part A** contains **10** questions (**2** questions from each module), having **3** marks for each question. Students should answer **all** questions. **Part B** contains **2** questions from each module, of which student should answer any one. Each question can have maximum **2** subdivisions and carries **14** marks.

Course Level Assessment Questions

Course Outcome 1 (CO 1):

1. What is calomel electrode? Give the reduction reaction (3 Marks)
2. List three important advantages of potentiometric titration (3 Marks)
3. (a) Explain how electroless plating copper and nickel are carried out (10 Marks)
(b) Calculate the emf of the following cell at 30°C, $Zn / Zn^{2+} (0.1M) // Ag^+ (0.01M) // Ag$.
Given $E^0 Zn^{2+}/Zn = -0.76 V$, $E^0 Ag^+/Ag = 0.8 V$. (4 Marks)

Course Outcome 2 (CO 2)

1. State Beer Lambert's law (3 Marks)
2. List the important applications of IR spectroscopy (3 Marks)
3. (a) What is Chemical shift? What are factors affecting Chemical shift? How ^1H NMR spectrum of CH_3COCH_2Cl interpreted using the concept of chemical shift. (10 Marks)
(b) Calculate the force constant of HF molecule, if it shows IR absorption at 4138 cm^{-1} . Given that atomic masses of hydrogen and fluorine are 1u and 19u respectively. (4 Marks)

Course Outcome 3 (CO 3):

1. Distinguish between TGA and DTA (3 Marks)
2. Give two differences between GSC and GLC (3 Marks)

3. (a) Explain the principle, instrumentation and procedure of HPLC (10 Marks)

(b) Interpret TGA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ (4 Marks)

Course Outcome 4 (CO 4):

1. Explain the geometrical isomerism in double bonds (3 Marks)

2. What are the rules of assigning R-S notation? (3 Marks)

3. (a) What are conducting polymers? How it is classified? Give the preparation of polyaniline (10 Marks)

(b) Draw the stereoisomers possible for $\text{CH}_3\text{-(CHOH)}_2\text{-COOH}$ (4 Marks)

Course Outcome 5 (CO 5):

1. What is degree of hardness? (3 Marks)

2. Define BOD and COD (3 Marks)

3. (a) Explain the EDTA estimation of hardness (10 Marks)

(b) Standard hard water contains 20 g of CaCO_3 per liter, 50 mL of this required 30 mL of EDTA solution, 50 mL of sample water required 20 mL of EDTA solution. 50 mL sample water after boiling required 14 mL EDTA solution. Calculate the temporary hardness of the given sample of water, in terms of ppm. (4 Marks)

MODEL QUESTION PAPER

Total Pages:

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIRST SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CYT100,

Course Name: ENGINEERING CHEMISTRY

Max. Marks: 100

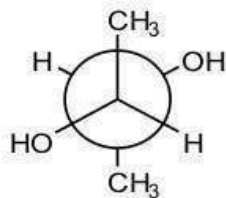
Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks

- | | | Marks |
|---|--|-------|
| 1 | What is potentiometric titration? How the end point is determined graphically? | (3) |
| 2 | What is Galvanic series? How is it different from electrochemical series? | (3) |
| 3 | Which of the following molecules can give IR absorption? Give reason? | (3) |
| | (a) O_2 (b) H_2O (c) N_2 (d) HCl | |
| 4 | Which of the following molecules show UV-Visible absorption? Give reason. | (3) |
| | (a) Ethane (b) Butadiene (c) Benzene | |

- 5 What are the visualization techniques used in TLC? (3)
- 6 Write the three important applications of nanomaterials. (3)
- 7 Draw the Fischer projection formula and find R-S notation of (3)



- 8 Write the structure of a) Polypyrrole b) Kevlar. (3)
- 9 What is break point chlorination? (3)
- 10 What is reverse osmosis? (3)

PART B

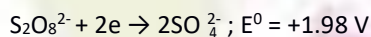
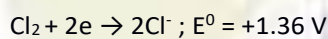
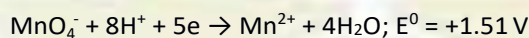
Answer any one full question from each module, each question carries 14 marks

Module 1

- 11 a) Give the construction of Li-ion cell. Give the reactions that take place at the electrodes during charging and discharging. What happens to anodic material when the cell is 100% charged. (10)
- b) Calculate the standard electrode potential of Cu, if its electrode potential at 25 °C is 0.296 V and the concentration of Cu^{2+} is 0.015 M. (4)

OR

- 12 a) Explain the mechanism of electrochemical corrosion of iron in oxygen rich and oxygen deficient acidic and basic environments. (10)
- b) Given below are reduction potentials of some species (4)



Use the above data to examine whether the acids, dil. HCl and dil. H_2SO_4 , can be used to provide acid medium in redox titrations involving KMnO_4 .

Module 2

- 13 a) What is spin-spin splitting? Draw the NMR spectrum of (i) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ (ii) $\text{CH}_3\text{CH}(\text{Br})\text{CH}_3$ Explain how NMR spectrum can be used to identify the two isomers. (10)
- b) A dye solution of concentration 0.08M shows absorbance of 0.012 at 600 nm; while a test solution of same dye shows absorbance of 0.084 under same conditions. Find the concentration of the test solution. (4)

OR

- 14 a) Explain the basic principle of UV-Visible spectroscopy. What are the possible electronic transitions? Explain with examples. (10)
- b) Sketch the vibrational modes of CO_2 and H_2O . Which of them are IR active? (4)

Module 3

- 15 a) Explain the principle, instrumentation and procedure involved in gas chromatography. (10)
b) Explain the DTA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ with a neat sketch. (4)

OR

- 16 a) Explain the various chemical methods used for the synthesis of nanomaterial (10)
b) How TGA is used to analyse the thermal stability of polymers? (4)

Module 4

- 17 a) What are conformers? Draw the *cis* and *trans* isomers of 1,3-dimethylcyclohexane. (10)
Which conformer (chair form) is more stable in each case?
b) What is ABS? Give properties and applications. (4)

OR

- 18 a) Explain the various structural isomers with suitable example. (10)
b) What is OLED? Draw a labelled diagram. (4)

Module 5

- 19 a) What are ion exchange resins? Explain ion exchange process for removal of hardness of water? How exhausted resins are regenerated? (10)
b) 50 mL sewage water is diluted to 2000 mL with dilution water; the initial dissolved oxygen was 7.7 ppm. The dissolved oxygen level after 5 days of incubation was 2.4 ppm. Find the BOD of the sewage. (4)

OR

- 20 a) What are the different steps in sewage treatment? Give the flow diagram. Explain the working of trickling filter. (10)
b) Calculate the temporary and permanent hardness of a water sample which contains $[\text{Ca}^{2+}] = 160 \text{ mg/L}$, $[\text{Mg}^{2+}] = 192 \text{ mg/L}$ and $[\text{HCO}_3^-] = 122 \text{ mg/L}$. (4)

Syllabus

Module 1

Electrochemistry and Corrosion

Introduction - Differences between electrolytic and electrochemical cells - Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes - SHE - Calomel electrode - Glass Electrode - Construction and Working. Single electrode potential - definition - Helmholtz electrical double layer - Determination of E^0 using calomel electrode. Determination of pH using glass electrode. Electrochemical series and its applications. Free energy and EMF - Nernst Equation - Derivation - single electrode and cell (Numericals) - Application - Variation of emf with temperature. Potentiometric titration - Introduction - Redox titration only. Lithium ion cell - construction and working. Conductivity - Measurement of conductivity of a solution (Numericals).

Corrosion - Electrochemical corrosion - mechanism. Galvanic series - cathodic protection - electroless plating - Copper and Nickel plating.

Module 2

Spectroscopic Techniques and Applications

Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals). UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications. IR-Spectroscopy – Principle - Number of vibrational modes - Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications. ^1H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).

Module 3

Instrumental Methods and Nanomaterials

Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$. Chromatographic methods - Basic principles and applications of column and TLC- Retention factor. GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.

Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).

Module 4

Stereochemistry and Polymer Chemistry

Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations). R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples. Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.

Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications. Kevlar-preparation, properties and applications. Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.

Module 5

Water Chemistry and Sewage Water Treatment

Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of

hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. Municipal water treatment (brief) - Disinfection methods - chlorination, ozone and UV irradiation.

Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD- definition, estimation (only brief procedure) and significance (Numericals). Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process.

Text Books

1. B. L. Tembe, Kamaluddin, M. S. Krishnan, "Engineering Chemistry (NPTEL Web-book)", 2018.
2. P. W. Atkins, "Physical Chemistry", Oxford University Press, 10th edn., 2014.

Reference Books

1. C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw-Hill, 4th edn., 1995.
2. Donald L. Pavia, "Introduction to Spectroscopy", Cengage Learning India Pvt. Ltd., 2015.
3. B. R. Puri, L. R. Sharma, M. S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., 47th Edition, 2017.
4. H. H. Willard, L. L. Merritt, "Instrumental Methods of Analysis", CBS Publishers, 7th Edition, 2005.
5. Ernest L. Eliel, Samuel H. Wilen, "Stereo-chemistry of Organic Compounds", WILEY, 2008.
6. Raymond B. Seymour, Charles E. Carraher, "Polymer Chemistry: An Introduction", Marcel Dekker Inc; 4th Revised Edition, 1996.
7. Muhammed Arif, Annette Fernandez, Kavitha P. Nair "Engineering Chemistry", Owl Books, 2019.
8. Ahad J., "Engineering Chemistry", Jai Publication, 2019.
9. Roy K. Varghese, "Engineering Chemistry", Crownplus Publishers, 2019.
10. Soney C. George, Rino Laly Jose, "Text Book of Engineering Chemistry", S. Chand & Company Pvt Ltd, 2019.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures (hrs)
1	Electrochemistry and Corrosion	9
1.1	Introduction - Differences between electrolytic and electrochemical cells- Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes- SHE - Calomel electrode - Glass Electrode - Construction and Working.	2
1.2	Single electrode potential – definition - Helmholtz electrical double layer - Determination of E^0 using calomel electrode. Determination of pH using glass electrode. Electrochemical series and its applications. Free energy and EMF - Nernst Equation – Derivation - single electrode and cell (Numericals) -Application -Variation of emf with temperature.	3
1.3	Potentiometric titration - Introduction -Redox titration only. Lithiumion cell - construction and working. Conductivity- Measurement of conductivity of a solution (Numericals).	2
1.4	Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.	2
2	Spectroscopic Techniques and Applications	9
2.1	Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals).	2
2.2	UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.	2
2.3	IR-Spectroscopy – Principle - Number of vibrational modes -Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications.	2
2.4	^1H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).	3
3	Instrumental Methods and Nanomaterials	9
3.1	Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$.	2

3.2	Chromatographic methods - Basic principles and applications of column and TLC-Retention factor.	2
3.3	GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.	2
3.4	Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).	3
4	Stereochemistry and Polymer Chemistry	9
4.1	Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations).	2
4.2	R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.	1
4.3	Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.	2
4.4	Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications. Kevlar-preparation, properties and applications. Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.	4
5	Water Chemistry and Sewage Water Treatment	9
5.1	Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages.	3
5.2	Municipal water treatment (brief) - Disinfection methods - chlorination, ozone and UV irradiation.	2
5.3	Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals).	2
5.4	Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram - Trickling filter and UASB process.	2

CYL 120	ENGINEERING CHEMISTRY LAB	CATEGORY	L	T	P	CREDIT
		BSC	0	0	2	1

Preamble: To impart scientific approach and to familiarize with the experiments in chemistry relevant for research projects in higher semesters

Prerequisite: Experiments in chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Understand and practice different techniques of quantitative chemical analysis to generate experimental skills and apply these skills to various analyses
CO 2	Develop skills relevant to synthesize organic polymers and acquire the practical skill to use TLC for the identification of drugs
CO 3	Develop the ability to understand and explain the use of modern spectroscopic techniques for analysing and interpreting the IR spectra and NMR spectra of some organic compounds
CO 4	Acquire the ability to understand, explain and use instrumental techniques for chemical analysis
CO 5	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
CO 6	Function as a member of a team, communicate effectively and engage in further learning. Also understand how chemistry addresses social, economical and environmental problems and why it is an integral part of curriculum

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				2							3
CO 2	3				3							3
CO 3	3				3							3
CO 4	3				3							3
CO 5	3				1							3
CO 6	3				1							3

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS**LIST OF EXPERIMENTS (MINIMUM 8 MANDATORY)**

1. Estimation of total hardness of water-EDTA method
2. Potentiometric titration
3. Determination of cell constant and conductance of solutions.
4. Calibration of pH meter and determination of pH of a solution
5. Estimation of chloride in water
6. Identification of drugs using TLC
7. Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
8. Determination of molar absorptivity of a compound (KMnO_4 or any water soluble food colorant)
9. Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
10. Estimation of iron in iron ore
11. Estimation of copper in brass
12. Estimation of dissolved oxygen by Winkler's method
13. (a) Analysis of IR spectra (minimum 3 spectra) (b) Analysis of ^1H NMR spectra (minimum 3 spectra)
14. Flame photometric estimation of Na^+ to find out the salinity in sand
15. Determination of acid value of a vegetable oil
16. Determination of saponification of a vegetable oil

Reference Books

1. G. Svehla, B. Sivasankar, "Vogel's Qualitative Inorganic Analysis", Pearson, 2012.
2. R. K. Mohapatra, "Engineering Chemistry with Laboratory Experiments", PHI Learning, 2017.
3. Muhammed Arif, "Engineering Chemistry Lab Manual", Owl publishers, 2019.
4. Ahad J., "Engineering Chemistry Lab manual", Jai Publications, 2019.
5. Roy K Varghese, "Engineering Chemistry Laboratory Manual", Crownplus Publishers, 2019.
6. Soney C George, Rino Laly Jose, "Lab Manual of Engineering Chemistry", S. Chand & Company Pvt Ltd, New Delhi, 2019.

PHT 110	ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)	Category	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of acoustics to explain the nature and characterization of acoustic design and to provide a safe and healthy environment
CO 5	Apply the comprehended knowledge about laser and fibre optic communication systems in various engineering applications

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3							1	2			1
CO 5	3	2						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50

Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE MARKS	ESE MARKS	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.
(b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.
(b) A liquid of refractive index μ is introduced between the lens and glass plate. What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wavefunction?

2. What are excitons ?
3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.
(b) Calculate the first three energy values of an electron in a one dimensional box of width $1 \text{ \AA}$ in electron volt.

Course Outcome 4 (CO4):

1. Explain reverberation and reverberation time.
2. How ultrasonic waves are used in non-destructive testing.
3. (a) With a neat diagram explain how ultrasonic waves are produced by a piezoelectric oscillator.
(b) Calculate frequency of ultrasonic waves that can be produced by a nickel rod of length 4 cm. (Young's Modulus = 207 G Pa, Density = 8900 Kg /m³)

Course Outcome 5 (CO 5):

1. Distinguish between spontaneous emission and stimulated emission.
2. Explain optical resonators.
3. (a) Explain the construction and working of Ruby Laser.
(b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33.

Model Question paper

QP CODE:

PAGES:3

Reg No:_____

Name :_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: PHT 110

Course Name: Engineering Physics B

Max.Marks: 100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators.
2. Distinguish between longitudinal and transverse waves.
3. Write a short note on antireflection coating.
4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.
5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.
6. Explain surface to volume ratio of nanomaterials.
7. Define sound intensity level. Give the values of threshold of hearing and threshold of pain.
8. Describe the method of non-destructive testing using ultra sonic waves
9. Explain the condition of population inversion
10. Distinguish between step index and graded index fibre. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution. Discuss the cases of over damped, critically damped and under damped cases. (10)

- (b) The frequency of a tuning fork is 500 Hz and its Q factor is 7×10^4 . Find the relaxation time. Also calculate the time after which its energy becomes $1/10$ of its initial undamped value. (4)

12.(a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)

- (b) The equation of transverse vibration of a stretched string is given by $y = 0.00327 \sin (72.1x - 2.72t)$ m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv) Velocity of the wave. (4)

Module 2

13. (a) Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid? (10)

- (b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength $4800 \text{ \AA}$. Given $\beta = 0.0555 \text{ cm}$. (4)

14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)

- (b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15. (a) Derive time dependent and independent Schrodinger equations. (10)

- (b) An electron is confined to one dimensional potential box of length $2 \text{ \AA}$. Calculate the energies corresponding to the first and second quantum states in eV. (4)

16. (a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)

- (b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

17. (a) Explain reverberation and reverberation time? What is the significance of Reverberation time. Explain the factors affecting the acoustics of a building and their corrective measures? (10)

- (b) The volume of a hall is 3000 m^3 . It has a total absorption of 100 m^2 sabine. If the hall is filled with audience who add another 80 m^2 sabine, then find the difference in reverberation time. (4)

18. (a) With a neat diagram explain how ultrasonic waves are produced by piezoelectric oscillator. Also discuss the piezoelectric method of detection of ultrasonic waves. (10)

- (b) An ultrasonic source of 0.09 MHz sends down a pulse towards the sea bed which returns after 0.55 sec. The velocity of sound in sea water is 1800 m/s. Calculate the depth of the sea and the wavelength of the pulse. (4)

Module 5

19. (a) Outline the construction and working of Ruby laser. (8)
- (b) What is the principle of holography? How is a hologram recorded? (6)
20. (a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)
- (b) An optical fibre made with core of refractive index 1.5 and cladding with a fractional index difference of 0.0006. Find refractive index of cladding and numerical aperture. (4)

(14x5=70)



SYLLABUS

ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)

Module 1

Oscillations and Waves

Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2

Wave Optics

Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index,Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3

Quantum Mechanics & Nanotechnology

Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening Mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4

Acoustics & Ultrasonics

Acoustics, Classification of sound-Musical sound-Noise, Characteristics of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation), Factors affecting architectural acoustics and their remedies

Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator –Working, Detection of ultrasonic waves - Thermal and Piezoelectric

methods, Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid , Applications of ultrasonic waves -SONAR,NDT and Medical

Module 5

Laser and Fibre optics

Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle, Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) ,Applications of laser, Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications

Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors

Text Books

1. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition, 2019.
2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition, 2017.

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, "Nano:The Essentials", McGraw Hill India Ltd, 2007
7. B. B. Laud, "Lasers and Non linear optics", New age International Publishers, 2nd Edition ,2005
8. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition ,2017
9. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Oscillations and Waves (9 hours)	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	Wave Optics (9 hours)	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hrs
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	Quantum Mechanics & Nanotechnology (9hours)	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	Acoustics & Ultrasonics (9hrs)	
4.1	Acoustics, Classification of sound-Musical sound-Noise, Characteristics	3 hrs

	of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation)	
4.2	Factors affecting architectural acoustics and their remedies	1 hr
4.3	Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator – Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods	3hrs
4.4	Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid ,Applications of ultrasonic waves -SONAR,NDT and Medical.	2 hr
5	Laser and Fibre optics (9hours)	
5.1	Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle	2 hrs
5.2	Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) Applications of laser	3 hrs
5.3	Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications	1 hr
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

HUT 101	LIFE SKILLS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		MNC	2	0	2	---	2019

Preamble: Life skills are those competencies that provide the means for an individual to be resourceful and positive while taking on life's vicissitudes. Development of one's personality by being aware of the self, connecting with others, reflecting on the abstract and the concrete, leading and generating change, and staying rooted in time-tested values and principles is being aimed at. This course is designed to enhance the employability and maximize the potential of the students by introducing them to the principles that underly personal and professional success, and help them acquire the skills needed to apply these principles in their lives and careers.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	Define and Identify different life skills required in personal and professional life
CO 2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.
CO 3	Explain the basic mechanics of effective communication and demonstrate these through presentations.
CO 4	Take part in group discussions
CO 5	Use appropriate thinking and problem solving techniques to solve new problems
CO 6	Understand the basics of teamwork and leadership

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2		1	2	2	1	3
CO 2									3			2
CO 3						1			1	3		
CO 4										3		1
CO 5		3	2	1								
CO 6						1			3			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation

Total Marks: 50

Attendance	: 10 marks
Regular assessment	: 15 marks
Series test (one test only, should include first three modules)	: 25 marks

Regular assessment

➤ **Group Discussion (Marks: 9)**

Create groups of about 6 students each and engage them on a GD on a suitable topic for about 20 minutes. Parameters to be used for evaluation are as follows:

Communication Skills	: 3 marks
- Subject Clarity	: 2 marks
- Group Dynamics	: 2 marks
- Behaviours & Mannerisms	: 2 marks

➤ **Presentation Skills (Marks: 6)**

Identify a suitable topic and ask the students to prepare a presentation (preferably a power point presentation) for about 10 minutes. Parameters to be used for evaluation are as follows:

• Communication Skills	: 2 marks
• Platform Skills	: 2 marks
• Subject Clarity/Knowledge	: 2 marks

End Semester Examination

Total Marks: 50

Time: 2 hrs.

Part A: Short answer question (25 marks)

There will be one question from each MODULE (five questions in total, five marks each). Each question should be written in about maximum of 400 words. Parameters to be used for evaluation are as follows:

- (i) Content Clarity/Subject Knowledge
- (ii) Presentation style
- (iii) Organization of content

Part B: Case Study (25 marks)

The students will be given a case study with questions at the end. The students have to analyze the case and answer the question at the end. Parameters to be used for evaluation are as follows:

- (i) Analyze the case situation
- (ii) Key players/characters of the case
- (iii) Identification of the problem (both major & minor if exists)
- (iv) Bring out alternatives
- (v) Analyze each alternative against the problem
- (vi) Choose the best alternative
- (vii) Implement as solution
- (viii) Conclusion

(ix) Answer the question at the end of the case

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List 'life skills' as identified by WHO
2. What do you mean by effective communication?
3. What are the essential life skills required by a professional?

Course Outcome 2 (CO2)

1. Identify an effective means to deal with workplace stress.
2. How can a student apply journaling to stress management?
3. What is the PATH method? Describe a situation where this method can be used effectively.

Course Outcome 3 (CO3):

1. Identify the communication network structure that can be observed in the given situations. Describe them.
 - (a) A group discussion on development.
 - (b) An address from the Principal regarding punctuality.
 - (c) A reporter interviewing a movie star.
 - (d) Discussing the answers of a test with a group of friends.
2. Elucidate the importance of non-verbal communication in making a presentation
3. Differentiate between kinesics, proxemics, and chronemics with examples.

Course Outcome 4 (CO4):

1. How can a participant conclude a group discussion effectively?
2. 'Listening skills are essential for effectively participating in a group discussion.' Do you agree? Substantiate your answer.

Course Outcome 5 (CO5):

1. Illustrate the creative thinking process with the help of a suitable example
2. Translate the following problem from verbal to graphic form and find the solution : *In a quiz, Ananth has 50 points more than Bimal, Chinmay has 60 points less than Ananth, and Dharini is 20 points ahead of Chinmay. What is the difference in points between Bimal and Dharini?*

3. List at least five ways in which the problem "How to increase profit?" can be redefined

Course Outcome 6 (CO6):

1. A group of engineers decided to brainstorm a design issue on a new product. Since no one wanted to disagree with the senior members, new ideas were not flowing freely. What group dynamics technique would you suggest to avoid this 'groupthink'? Explain the procedure.
2. "A group focuses on individual contribution, while a team must focus on synergy." Explain.
3. Identify the type of group formed / constituted in each of the given situations
 - a) A Police Inspector with subordinates reporting to him
 - b) An enquiry committee constituted to investigate a specific incident
 - c) The Accounts Department of a company
 - d) A group of book lovers who meet to talk about reading

Syllabus

Module 1

Overview of Life Skills: Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem solving, Effective communication, interpersonal relationship, coping with stress, coping with emotion.

Life skills for professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, helping others, leadership, motivation, self-motivation, and motivating others, personality development, IQ, EQ, and SQ

Module 2

Self-awareness: definition, need for self-awareness; Coping With Stress and Emotions, Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback.

Stress Management: Stress, reasons and effects, identifying stress, stress diaries, the four A's of stress management, techniques, Approaches: action-oriented, emotion-oriented, acceptance-oriented, resilience, Gratitude Training,

Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques.

Morals, Values and Ethics: Integrity, Civic Virtue, Respect for Others, Living Peacefully. Caring, Sharing, Honesty, Courage, Valuing Time, Time management, Co operation, Commitment, Empathy, Self-Confidence, Character, Spirituality, Avoiding Procrastination, Sense of Engineering Ethics.

Module 3

21st century skills: Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.

Steps in problem solving: Problem Solving Techniques, Six Thinking Hats, Mind Mapping, Forced Connections. Analytical Thinking, Numeric, symbolic, and graphic reasoning. Scientific temperament and Logical thinking.

Module 4

Group and Team Dynamics: Introduction to Groups: Composition, formation, Cycle, thinking, Clarifying expectations, Problem Solving, Consensus, Dynamics techniques, Group vs Team, Team Dynamics, Virtual Teams. Managing team performance and managing conflicts, Intrapreneurship.

Module 5

Leadership: Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions. Growing as a leader, turnaround leadership, managing diverse stakeholders, crisis management. Types of Leadership, Traits, Styles, VUCA Leadership, Levels of Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders.

Lab Activities

Verbal

Effective communication and Presentation skills.

Different kinds of communication; Flow of communication; Communication networks, Types of barriers; Miscommunication

Introduction to presentations and group discussions.

Learning styles: visual, aural, verbal, kinaesthetic, logical, social, solitary; Previewing, KWL table, active listening, REAP method

Note-taking skills: outlining, non-linear note-taking methods, Cornell notes, three column note taking.

Memory techniques: mnemonics, association, flashcards, keywords, outlines, spider diagrams and mind maps, spaced repetition.

Time management: auditing, identifying time wasters, managing distractions, calendars and checklists; Prioritizing - Goal setting, SMART goals; Productivity tools and apps, Pomodoro technique.

Non Verbal:

Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language, Communication in a multi cultural environment.

Reference Books

1. Shiv Khera, *You Can Win*, Macmillan Books, New York, 2003.
2. Barun K. Mitra, *"Personality Development & Soft Skills"*, Oxford Publishers, Third impression, 2017.
3. ICT Academy of Kerala, *"Life Skills for Engineers"*, McGraw Hill Education (India) Private Ltd., 2016.
4. Caruso, D. R. and Salovey P, *"The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership"*, John Wiley & Sons, 2004.
5. Kalyana, *"Soft Skill for Managers"*; First Edition; Wiley Publishing Ltd, 2015.
6. Larry James, *"The First Book of Life Skills"*; First Edition, Embassy Books, 2016.
7. Shalini Verma, *"Development of Life Skills and Professional Practice"*; First Edition; Sultan Chand (G/L) & Company, 2014.
8. Daniel Goleman, *"Emotional Intelligence"*; Bantam, 2006.
9. Remesh S., Vishnu R.G., *"Life Skills for Engineers"*, Ridhima Publications, First Edition, 2016.
10. Butterfield Jeff, *"Soft Skills for Everyone"*, Cengage Learning India Pvt Ltd; 1 edition, 2011.
11. *Training in Interpersonal Skills: Tips for Managing People at Work*, Pearson Education, India; 6 edition, 2015.
12. *The Ace of Soft Skills: Attitude, Communication and Etiquette for Success*, Pearson Education; 1 edition, 2013.



MAT 101	LINEAR ALGEBRA AND CALCULUS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: This course introduces students to some basic mathematical ideas and tools which are at the core of any engineering course. A brief course in Linear Algebra familiarises students with some basic techniques in matrix theory which are essential for analysing linear systems. The calculus of functions of one or more variables taught in this course are useful in modelling and analysing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Prerequisite: A basic course in one-variable calculus and matrix theory.

Course Outcomes: After the completion of the course the student will be able to

CO 1	solve systems of linear equations, diagonalize matrices and characterise quadratic forms
CO 2	compute the partial and total derivatives and maxima and minima of multivariable functions
CO 3	compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminae
CO 4	perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent
CO 5	determine the Taylor and Fourier series expansion of functions and learn their applications.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	1			1	2		2
CO 2	3	3	3	3	2	1			1	2		2
CO 3	3	3	3	3	2	1			1	2		2
CO 4	3	2	3	2	1	1			1	2		2
CO 5	3	3	3	3	2	1			1	2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

Assignments: Assignment should include specific problems highlighting the applications of the methods introduced in this course in science and engineering.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Solve systems of linear equations, diagonalize matrices and characterise quadratic forms

1. A is a real matrix of order 3×3 and $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$. What can you say about the solution of $AX = 0$?

If rank of A is 1? 2? 3?

2. Given $A = \begin{bmatrix} 3 & 0 & 2 \\ 0 & 2 & 0 \\ -2 & 0 & 0 \end{bmatrix}$, find an orthogonal matrix P that diagonalizes A.

3. Find out what type of conic section the following quadratic form represents

$$17x^2 - 30x_1x_2 + 17x_2^2 = 128$$

4. The matrix $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ has an eigen value 5 with corresponding Eigen vector $X = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$. Find $A^5 X$

Course Outcome 2 (CO2): compute the partial and total derivatives and maxima and minima of multivariable functions

1. Find the slope of the surface $z = x^2y + 5y^3$ in the x-direction at the point (1,-2)

2. Given the function $w = xy + z$, use chain rule to find the instantaneous rate of change of w at each point along the curve $x = \cos t, y = \sin t, z = t$
3. Determine the dimension of rectangular box open at the top, having a volume 32 cubic ft and requiring the least amount of material for its construction.

Course Outcome 3 (CO3): compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas.

1. Evaluate $\iint_D (x + 2y) \, dA$ where D is the region bounded by the parabolas $y = 2x^2$ and $y = 1 + x^2$
2. Explain how you would find the volume under the surface $z = f(x, y)$ and over a specific region D in the xy -plane using (i) double integral (ii) triple integral?
3. Find the mass and centre of gravity of a triangular lamina with vertices $(0,0)$, $(2,1)$, $(0,3)$ if the density function is $f(x, y) = x + y$
4. Use spherical coordinates to evaluate $\iiint_B (x^2 + y^2 + z^2)^3 \, dV$ where B is the unit ball defined by $B = \{(x, y, z): x^2 + y^2 + z^2 \leq 1\}$

Course Outcome 4 (CO4): perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent.

1. What is the difference between a sequence and a series and when do you say that they are convergent? Divergent?
2. Determine whether the series $\sum_{n=1}^{\infty} \frac{5}{2n^2 + 4n + 3}$ converges or diverges.
3. Is the series $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{n}$ convergent? Absolutely convergent? Conditionally convergent?

Course Outcome 5 (CO5): determine the Taylor and Fourier series expansion of functions and learn their applications.

1. Assuming the possibility of expansion find the Maclaurin series expansion of $f(x) = (1 + x)^k$ for $|x| < 1$ where k is any real number. What happens if k is a positive integer?
2. Use Maclaurin series of $\ln(1 + x)$, $-1 < x \leq 1$ to find an approximate value of $\ln 2$.
3. Find the Fourier series of the function $f(x) = x^2$, $-2 \leq x < 2$, $f(x + 4) = f(x)$. Hence using Parseval's identity prove that $1 - \frac{1}{2^4} + \frac{1}{3^4} - \frac{1}{4^4} + \dots = \frac{\pi^4}{90}$
4. Expand the function $f(x) = x$ ($0 < x < 1/2$) into a (i) Fourier sine series (ii) Fourier cosine series.

Model Question paper

QP CODE:

PAGES:3

Reg No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR

Course Code: MAT 101

Max. Marks: 100

Duration: 3 Hours

LINEAR ALGEBRA AND CALCULUS

(2019-Scheme) (Common

to all branches)PART A

(Answer all questions, each question carries 3 marks)

- Determine the rank of the matrix $A = \begin{bmatrix} 1 & 2 & -1 \\ -2 & -4 & 2 \\ 3 & 6 & -3 \end{bmatrix}$.
- Write down the eigen values of $\begin{bmatrix} 2 & 0 \\ 0 & -1 \end{bmatrix}$. What are the eigen values of $P^{-1}AP$ where $P = \begin{bmatrix} -4 & 2 \\ 3 & -1 \end{bmatrix}$?
- Find $f_x(1,3)$ and $f_y(1,3)$ for the function $f(x, y) = 2x^3y^2 + 2y + 4x$.
- Show that the function $u(x, t) = \sin(x - ct)$ is a solution of the equation $\frac{6^2u}{6t^2} = c^2 \frac{6^2u}{6x^2}$.
- Use double integral to find the area of the region enclosed between the parabolas $y = x^2$ and the line $y = 2x$.
- Use polar coordinates to evaluate the area of the region bounded by $x^2 + y^2 = 4$, the line $y = x$ and the y axis in the first quadrant
- Test the convergence of the series $\sum_{k=1}^{\infty} \frac{k}{k+1}$.
- Test the convergence of the alternating series $\sum_{k=1}^{\infty} \frac{(-1)^{k+1}}{k}$ using Leibnitz test.
- Find the Taylor series expansion of $\sin \pi x$ about $x = \frac{\pi}{2}$.
- Find the values to which the Fourier series of

$f(x) = x$ for $-\pi < x < \pi$, with $f(x + 2\pi) = f(x)$ converges

(10x3=30)

PART B

(Answer **one full** question from each module, each question carries **14** marks)

Module -I

11. (a) Solve the following system of equations

$$\begin{aligned} y + z - 2w &= 0 \\ 2x - 3y - 3z + 6w &= 2 \\ 4x + y + z - 2w &= 4 \end{aligned}$$

- (b) Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$

12. (a) Diagonalize the matrix $\begin{bmatrix} -1 & 2 & -2 \\ 2 & 4 & 1 \\ 2 & 1 & 4 \end{bmatrix}$

- (b) What kind of conic section the quadratic form $3x_1^2 + 22x_1x_2 + 3x_2^2 = 0$ represents?

Transform it to principal axes.

Module - II

13. (a) Find the local linear approximation to $f(x, y) = \sqrt{x^2 + y^2}$ at the point $(3, 4)$. Use it to approximate $f(3.04, 3.98)$

- (b) Let $w = \sqrt{x^2 + y^2 + z^2}$, $x = \cos\theta$, $y = \sin\theta$, $z = \tan\theta$. Use chain rule to find $\frac{dw}{d\theta}$ when $\theta = \frac{\pi}{4}$.

14. (a) Let $z = f(x, y)$ where $x = r\cos\theta$, $y = r\sin\theta$, prove that

$$\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2 + \frac{1}{r^2} \left(\frac{\partial z}{\partial \theta}\right)^2.$$

- (b) Locate all relative maxima, relative minima and saddle points

$$f(x, y) = xy + \frac{a^3}{x} + \frac{b^3}{y} \quad (a \neq 0, b \neq 0).$$

Module - III

15. (a) Evaluate $\iint_D (2x^2y + 9y^3) \, dx \, dy$ where D is the region bounded by $y = \frac{2}{3}x$ and $y = 2\sqrt{x}$

- (b) Evaluate $\int_0^4 \int_{\sqrt{y}}^2 e^x \, dx \, dy$ changing the order of integration.

16. (a) Find the volume of the solid bounded by the cylinder $x^2 + y^2 = 4$ and the planes $y + z = 4$ and $z = 0$.

- (b) Evaluate $\iiint \sqrt{1 - x^2 - y^2 - z^2} \, dx \, dy \, dz$, taken throughout the volume of the sphere $x^2 + y^2 + z^2 = 1$, by transforming to spherical polar coordinates

Module - IV

17. (a) Test the convergence of the series

$$(i) \sum_{k=1}^{\infty} \frac{k^k}{k!} \quad (ii) \sum_{k=2}^{\infty} \frac{(4k-5)^k}{2^{k+1}}$$

- (b) Determine the convergence or divergence of the series $\sum_{k=1}^{\infty} (-1)^k \frac{(2k-1)!}{3^k}$

18. (a) Check whether the series $\sum_{k=1}^{\infty} (-1)^{k+1} \frac{(2k)!}{(3k-2)!}$ is absolutely convergent, conditionally convergent or divergent.

(b) Test the convergence of the series $1 + \frac{1.2}{1.3} + \frac{1.2.3}{1.3.5} + \frac{1.2.3.4}{1.3.5.7} + \dots$

Module - V

19. (a) Obtain the Fourier series of $f(x) = e^{-x}$, in the interval $0 < x < 2\pi$. with $f(x + 2\pi) = f(x)$. Hence deduce the value of $\sum_{n=2}^{\infty} \frac{(-1)^n}{1+n^2}$

$$\frac{2kL}{L} \quad \text{if } 0 < x < \frac{L}{2}$$

(b) Find the half range sine series of $f(x) = \begin{cases} x & \text{if } 0 < x < \frac{L}{2} \\ \frac{2k(L-x)}{L} & \text{if } \frac{L}{2} < x < L \end{cases}$

20. (a) Expand $(1+x)^{-2}$ as a Taylor series about $x=0$ and state the region of convergence of the series.

(b) Find the Fourier series for $f(x) = x^2$ in the interval $-\pi < x < \pi$ with $f(x + 2\pi) = f(x)$. Hence show that $\frac{1}{1^4} - \frac{1}{2^4} + \frac{1}{3^4} - \frac{1}{4^4} + \dots = \frac{\pi^4}{90}$

(14X5=70)

Syllabus

Module 1 (Linear algebra)

(Text 2: Relevant topics from sections 7.3, 7.4, 7.5, 8.1, 8.3, 8.4)

Systems of linear equations, Solution by Gauss elimination, row echelon form and rank of a matrix, fundamental theorem for linear systems (homogeneous and non-homogeneous, without proof), Eigen values and eigen vectors. Diagonalization of matrices, orthogonal transformation, quadratic forms and their canonical forms.

Module 2 (multivariable calculus-Differentiation)

(Text 1: Relevant topics from sections 13.3, 13.4, 13.5, 13.8)

Concept of limit and continuity of functions of two variables, partial derivatives, Differentials, Local Linear approximations, chain rule, total derivative, Relative maxima and minima, Absolute maxima and minima on closed and bounded set.

Module 3 (multivariable calculus-Integration)

(Text 1: Relevant topics from sections 14.1, 14.2, 14.3, 14.5, 14.6, 14.8)

Double integrals (Cartesian), reversing the order of integration, Change of coordinates (Cartesian to polar), finding areas and volume using double integrals, mass and centre of gravity of inhomogeneous laminas using double integral. Triple integrals, volume calculated as triple integral, triple integral in cylindrical and spherical coordinates (computations involving spheres, cylinders).

Module 4 (sequences and series)

(Text 1: Relevant topics from sections 9.1, 9.3, 9.4, 9.5, 9.6)

Convergence of sequences and series, convergence of geometric series and p-series(without proof), test of convergence (comparison, ratio and root tests without proof); Alternating series and Leibnitz test, absolute and conditional convergence.

Module 5 (Series representation of functions)

(Text 1: Relevant topics from sections 9.8, 9.9. Text 2: Relevant topics from sections 11.1, 11.2, 11.6)

Taylor series (without proof, assuming the possibility of power series expansion in appropriate domains), Binomial series and series representation of exponential, trigonometric, logarithmic functions (without proofs of convergence); Fourier series, Euler formulas, Convergence of Fourier series (without proof), half range sine and cosine series, Parseval's theorem (without proof).

Text Books

1. H. Anton, I. Biven, S. Davis, "Calculus", Wiley, 10th edition, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2016.

Reference Books

1. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition, 2012
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36 Edition, 2010.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Linear Algebra (10 hours)	
1.1	Systems of linear equations, Solution by Gauss elimination	1
1.2	Row echelon form, finding rank from row echelon form, fundamental theorem for linear systems	3
1.3	Eigen values and eigen vectors	2
1.4	Diagonalization of matrices, orthogonal transformation, quadratic forms	4

	and their canonical forms.	
2	Multivariable calculus-Differentiation (8 hours)	
2.1	Concept of limit and continuity of functions of two variables, partial derivatives	2
2.2	Differentials, Local Linear approximations	2
2.3	Chain rule, total derivative	2
2.4	Maxima and minima	2
3	Multivariable calculus-Integration (10 hours)	
3.1	Double integrals (Cartesian)-evaluation	2
3.2	Change of order of integration in double integrals, change of coordinates (Cartesian to polar),	2
3.3	Finding areas and volumes, mass and centre of gravity of plane laminas	3
3.4	Triple integrals	3
4	Sequences and series (8 hours)	
4.1	Convergence of sequences and series, geometric and p-series	2
4.2	Test of convergence(comparison, ratio and root)	4
4.3	Alternating series and Leibnitz test, absolute and conditional convergence	2
5	Series representation of functions (9 hours)	
5.1	Taylor series, Binomial series and series representation of exponential, trigonometric, logarithmic functions;	3
5.2	Fourier series, Euler formulas, Convergence of Fourier series(Dirichlet's conditions)	3
5.3	Half range sine and cosine series, Parseval's theorem.	3

HUT 102	PROFESSIONAL COMMUNICATION	CATEGORY	L	T	P	CREDIT
		MNC	2	0	2	--

Preamble: Clear, precise, and effective communication has become a *sine qua non* in today's information-driven world given its interdependencies and seamless connectivity. Any aspiring professional cannot but master the key elements of such communication. The objective of this course is to equip students with the necessary skills to listen, read, write, and speak so as to comprehend and successfully convey any idea, technical or otherwise, as well as give them the necessary polish to become persuasive communicators.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop vocabulary and language skills relevant to engineering as a profession
CO 2	Analyze, interpret and effectively summarize a variety of textual content
CO 3	Create effective technical presentations
CO 4	Discuss a given technical/non-technical topic in a group setting and arrive at generalizations/consensus
CO 5	Identify drawbacks in listening patterns and apply listening techniques for specific needs
CO 6	Create professional and technical documents that are clear and adhering to all the necessary conventions

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1										3		2
CO 2										1		3
CO 3						1			1	3		
CO 4										3		1
CO 5		1							2	3		
CO 6	1					1			1	3		

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation

Total Marks: 50

Attendance	: 10 marks
Regular assessment	: 25 marks
Series test (one test only, should include verbal aptitude for placement and higher studies, this test will be conducted for 50 marks and reduced to 15)	: 15 marks

Regular assessment

Project report presentation and Technical presentation through PPT	: 7.5 marks
Listening Test	: 5 marks
Group discussion/mock job interview	: 7.5 marks
Resume submission	: 5 marks

End Semester Examination

Total Marks: 50, Time: 2 hrs.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List down the ways in which gestures affect verbal communication.
2. Match the words and meanings
Ambiguous promotion
Bona fide referring to whole
Holistic not clear
Exaltation genuine
3. Expand the following Compound Nouns - a. Water supply. b. Object recognition. c. Steam turbine

Course Outcome 2 (CO2)

1. Read the passage below and prepare notes:

Mathematics, rightly viewed, possesses not only truth, but supreme beauty—a beauty cold and austere, like that of sculpture, without appeal to any part of our weaker nature, without the gorgeous trappings of painting or music, yet sublimely pure, and capable of a stern perfection such as only the greatest art can show. The true spirit of delight, the exaltation, the sense of being more than man, which is the touchstone of the highest excellence, is to be found in mathematics as surely as in poetry. What is best in mathematics deserves not merely to be learnt as a task, but to be assimilated as a part of daily thought, and brought again and again before the mind with ever-renewed encouragement. Real life is, to most men, a long second-best, a perpetual compromise between the ideal and the possible; but the world of pure reason knows no compromise, no practical limitations, no barrier to the creative activity embodying in splendid edifices the passionate aspiration after the perfect from which all great work springs. Remote from human passions, remote even from the pitiful facts of nature, the generations have gradually created an ordered cosmos, where pure thought can dwell as in its natural home, and where one, at least, of our nobler impulses can escape from the dreary exile of the actual world.

So little, however, have mathematicians aimed at beauty, that hardly anything in their work has had this conscious purpose. Much, owing to irrepressible instincts, which were better than avowed

beliefs, has been moulded by an unconscious taste; but much also has been spoilt by false notions of what was fitting. The characteristic excellence of mathematics is only to be found where the reasoning is rigidly logical: the rules of logic are to mathematics what those of structure are to architecture. In the most beautiful work, a chain of argument is presented in which every link is important on its own account, in which there is an air of ease and lucidity throughout, and the premises achieve more than would have been thought possible, by means which appear natural and inevitable. Literature embodies what is general in particular circumstances whose universal significance shines through their individual dress; but mathematics endeavours to present whatever is most general in its purity, without any irrelevant trappings.

How should the teaching of mathematics be conducted so as to communicate to the learner as much as possible of this high ideal? Here experience must, in a great measure, be our guide; but some maxims may result from our consideration of the ultimate purpose to be achieved.

- From "On the teaching of mathematics" – Bertrand Russell

2. Enumerate the advantages and disadvantages of speed reading. Discuss how it can impact comprehension.

Course Outcome 3(CO3):

1. What are the key elements of a successful presentation?
2. Elucidate the importance of non-verbal communication in making a presentation
3. List out the key components in a technical presentation.

Course Outcome 4 (CO4):

1. Discuss: 'In today's world, being a good listener is more important than being a good Speaker.'
2. Listen to a video/live group discussion on a particular topic, and prepare a brief summary of the proceedings.
3. List the do's and don'ts in a group discussion.

Course Outcome 5 (CO5):

1. Watch a movie clip and write the subtitles for the dialogue.
2. What do you mean by barriers to effective listening? List ways to overcome each of these.
3. What are the different types of interviews? How are listening skills particularly important in Skype/telephonic interviews?

Course Outcome 6 (CO6):

1. Explain the basic structure of a technical report.
2. You have been offered an internship in a much sought-after aerospace company and are very excited about it. However, the dates clash with your series tests. Write a letter to the Manager – University Relations of the company asking them if they can change the dates to coincide with your vacation.
3. You work in a well-reputed aerospace company as Manager – University Relations. You are in charge of offering internships. A student has sent you a letter requesting you to change the dates allotted to him since he has series exams at that time. But there are no vacancies available during the period he has requested for. Compose an e-mail informing him of this and suggest that he try to arrange the matter with his college.

Syllabus

Module 1

Use of language in communication: Significance of technical communication Vocabulary Development: technical vocabulary, vocabulary used in formal letters/emails and reports, sequence words, misspelled words, compound words, finding suitable synonyms, paraphrasing, verbal analogies. Language Development: subject-verb agreement, personal passive voice, numerical adjectives, embedded sentences, clauses, conditionals, reported speech, active/passive voice.

Technology-based communication: Effective email messages, slide presentations, editing skills using software. Modern day research and study skills: search engines, repositories, forums such as Git Hub, Stack Exchange, OSS communities (MOOC, SWAYAM, NPTEL), and Quora; Plagiarism

Module 2

Reading, Comprehension, and Summarizing: Reading styles, speed, valuation, critical reading, reading and comprehending shorter and longer technical articles from journals, newspapers, identifying the various transitions in a text, SQ3R method, PQRS method, speed reading. Comprehension: techniques, understanding textbooks, marking and underlining, Note-taking: recognizing non-verbal cues.

Module 3

Oral Presentation: Voice modulation, tone, describing a process, Presentation Skills: Oral presentation and public speaking skills, business presentations, Preparation: organizing the material, self-Introduction, introducing the topic, answering questions, individual presentation practice, presenting visuals effectively.

Debate and Group Discussions: introduction to Group Discussion (GD), differences between GD and debate; participating GD, understanding GD, brainstorming the topic, questioning and clarifying, GD strategies, activities to improve GD skills

Module 4

Listening and Interview Skills Listening: Active and Passive listening, listening: for general content, to fill up information, intensive listening, for specific information, to answer, and to understand. Developing effective listening skills, barriers to effective listening, listening to longer technical talks, listening to classroom lectures, talks on engineering /technology, listening to documentaries and making notes, TED talks.

Interview Skills: types of interviews, successful interviews, interview etiquette, dress code, body language, telephone/online (skype) interviews, one-to-one interview & panel interview, FAQs related to job interviews

Module 5

Formal writing: Technical Writing: differences between technical and literary style. Letter Writing (formal, informal and semi formal), Job applications, Minute preparation, CV preparation (differences between Bio-Data, CV and Resume), and Reports. Elements of style, Common Errors in Writing: describing a process, use of sequence words, Statements of Purpose, Instructions, Checklists.

Analytical and issue-based Essays and Report Writing: basics of report writing; Referencing Style (IEEE Format), structure of a report; types of reports, references, bibliography.

Lab Activities

Written: Letter writing, CV writing, Attending a meeting and Minute Preparation, Vocabulary Building

Spoken: Phonetics, MMFS (Multimedia Feedback System), Mirroring, Elevator Pitch, telephone etiquette, qualities of a good presentation with emphasis on body language and use of visual aids.

Listening: Exercises based on audio materials like radio and podcasts. Listening to Song. practice and exercises.

Reading: Speed Reading, Reading with the help of Audio Visual Aids, Reading Comprehension Skills

Mock interview and Debate/Group Discussion: concepts, types, Do's and don'ts- intensive practice

Reference Books

1. English for Engineers and Technologists (Combined edition, Vol. 1 and 2), Orient Blackswan 2010.
2. Meenakshi Raman and Sangeetha Sharma, "Technical Communication: Principles and Practice", 2nd Edition, Oxford University Press, 2011
3. Stephen E. Lucas, "The Art of Public Speaking", 10th Edition; McGraw Hill Education, 2012.
4. Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw Hill Education, 2017.
5. William Strunk Jr. & E.B. White, "The Elements of Style", 4th Edition, Pearson, 1999.
6. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Wiley. New York, 2004.
7. Goodheart-Willcox, "Professional Communication", First Edition, 2017.
8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 edition, 2015.
9. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.
10. Anand Ganguly, "Success in Interview", RPH, 5th Edition, 2016.
11. Raman Sharma, "Technical Communications", Oxford Publication, London, 2004.

EST 110	ENGINEERING GRAPHICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	0	2	3	2019

Preamble: To enable the student to effectively perform technical communication through graphical representation as per global standards.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Draw the projection of points and lines located in different quadrants
CO 2	Prepare multiview orthographic projections of objects by visualizing them in different positions
CO 3	Draw sectional views and develop surfaces of a given object
CO 4	Prepare pictorial drawings using the principles of isometric and perspective projections to visualize objects in three dimensions.
CO 5	Convert 3D views to orthographic views
CO 6	Obtain multiview projections and solid models of objects using CAD tools

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3											
CO 2	3											
CO 3	3	1										
CO 4	3									1		
CO 5	3									2		
CO 6	3				3					3		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (100 Marks)
	Test 1 (15 Marks)	Test 2 (15 Marks)	
Remember			
Understand	5		20
Apply	10	10	80
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

CIA for section A carries 25 marks (15 marks for 1 test and Class work 10 marks)

CIA for section B carries 15 marks (10 marks for 1 test and Class work 5 marks)

End Semester Examination Pattern:

ESE will be of 3 hour duration on A4 size answer booklet and will be for 100 marks. The question paper shall contain two questions from each module of Section A only. Student has to answer any one question from each module. Each question carries 20 marks.

Course Level Assessment Questions

(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1):

1. Locate points in different quadrants as per given conditions.
2. Problems on lines inclined to both planes .
3. Find True length, Inclinations and Traces of lines.

Course Outcome 2 (CO2)

1. Draw orthographic views of solids and combination solids
2. Draw views of solids inclined to any one reference plane.
3. Draw views of solids inclined to both reference planes.

Course Outcome 3 (CO3):

1. Draw views of solids sectioned by a cutting plane
2. Find location and inclination of cutting plane given true shape of the section
3. Draw development of lateral surface of solids and also its sectioned views

Course Outcome 4 (CO4):

1. Draw Isometric views/projections of solids
2. Draw Isometric views/projections of combination of solids
3. Draw Perspective views of Solids

Course Outcome 5 (CO5):

1. Draw Orthographic views of solids from given three dimensional view

Course Outcome 6 (CO6):

1. Draw the given figure including dimensions using 2D software
2. Create 3D model using modelling software from the given orthographic views or 3D figure or from real 3D objects

Model Question paper

QP CODE:

PAGES:3

Reg No:_____

Name :_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: EST 110

ENGINEERING GRAPHICS

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

Instructions: Retain necessary Construction lines

Show necessary dimensions

Answer any ONE question from each module

Each question carries 20 marks

MODULE I

1. The end point A of a line is 20mm above HP and 10mm in front of VP. The other end of the line is 50mm above HP and 15mm behind VP. The distance between the end projectors is 70mm. Draw the projections of the line. Find the true length and true inclinations of the line with the principal planes. Also locate the traces of the line.
2. One end of a line is 20mm from both the principal planes of projection. The other end of the line is 50mm above HP and 40mm in front of VP. The true length of the line is 70mm. Draw the projections of the line. Find its apparent inclinations, elevation length and plan length. Also locate its traces.

MODULE II

3. A pentagonal pyramid of base side 25mm and height 40mm, is resting on the ground on one of its triangular faces. The base edge of that face is inclined 30° to VP. Draw the projections of the solid.

4. A hexagonal prism has side 25mm and height 50mm has a corner of its base on the ground and the long edge containing that corner inclined at 30° to HP and 45° to VP. Draw the projections of the solid.

MODULE III

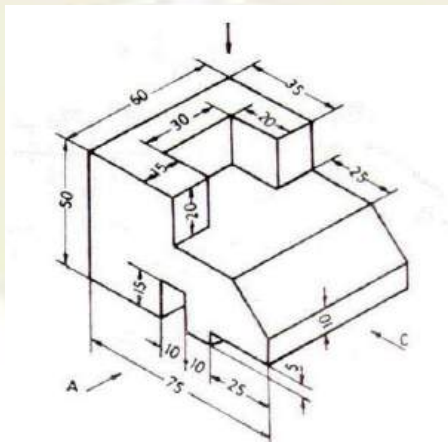
5. A triangular prism of base side 40mm and height 70mm is resting with its base on the ground and having an edge of the base perpendicular to VP. Section the solid such that the true shape of the section is a trapezium of parallel sides 30mm and 10mm. Draw the projections showing the true shape. Find the inclination of the cutting plane with the ground plane.
6. Draw the development of a pentagonal pyramid of base side 30mm and height 50mm. A string is wound from a corner of the base round the pyramid and back to the same point through the shortest distance. Show the position of the string in the elevation and plan.

MODULE IV

7. The frustum of a cone has base diameter 50mm and top diameter 40mm has a height of 60mm. It is placed centrally on top of a rectangular slab of size 80x60mm and of thickness 20mm. Draw the isometric view of the combination.
8. A hexagonal prism has base side 35mm and height 60mm. A sphere of diameter 40mm is placed centrally on top of it. Draw the isometric projection of the combination.

MODULE V

9. Draw the perspective view of a pentagonal prism, 20mm side and 45mm long lying on one of its rectangular faces on the ground and having its axis perpendicular to picture plane. One of its pentagonal faces touches the picture plane and the station point is 50mm in front of PP, 25mm above the ground plane and lies in a central plane, which is 70mm to the left of the center of the prism.
10. Draw three orthographic views with dimensions of the object shown in figure below.



(20X5=100)

SCHEME OF VALUATION

1. Locating the points and drawing the projections of the line – 4 marks
Finding true length by any one method – 6 marks
Finding true inclination with VP – 2 marks
Finding true inclination with HP – 2 marks
Locating horizontal trace – 2 marks
Locating vertical trace – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

2. Locating the points and drawing true length of the line – 4 marks
Finding projections by any method – 6 marks
Finding length of elevation and plan – 2 marks
Finding apparent inclinations – 2 marks
Locating horizontal trace – 2 marks
Locating vertical trace – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

3. Drawing initial position plan and elevation – 4 marks
First inclination views – 4 marks
Second inclination views -8 marks
Marking invisible edges – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

*(Any one method or combination of methods for solving can be used.**If initial position is wrong then maximum 50% marks may be allotted for the answer)*

4. Drawing initial position plan and elevation – 4 marks
First inclination views – 4 marks
Second inclination views -8 marks
Marking invisible edges – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

*(Any one method or combination of methods for solving can be used**If initial position is wrong then maximum 50% marks may be allotted for the answer)*

5. Drawing initial position plan and elevation – 4 marks
Locating section plane as per given condition – 5 marks
Drawing true shape -5 marks
Finding inclination of cutting plane – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

6. Drawing initial position plan and elevation – 4 marks
Development of the pyramid – 6 marks

Locating string in development -2 marks
Locating string in elevation – 3 marks
Locating string in plan – 3 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

7. Drawing initial positions – 4 marks
Isometric View of Slab -6 marks
Isometric View of Frustum – 10 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

*(Initial position is optional, hence redistribute if needed.
Reduce 4 marks if Isometric scale is taken)*

8. Drawing initial positions – 4 marks
Isometric scale – 4 marks
Isometric projection of prism -5 marks
Isometric projection of sphere – 5 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

(Initial position is optional, hence redistribute if needed.

9. Drawing the planes and locating the station point – 4 marks
Locating elevation points – 2 marks
Locating plan points – 2 marks
Drawing the perspective view – 10 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

10. Drawing the elevation – 8 marks
Drawing the plan – 4 marks
Drawing the side view – 4 marks
Marking invisible edges – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

SYLLABUS

General Instructions:

- First angle projection to be followed
- Section A practice problems to be performed on A4 size sheets
- Section B classes to be conducted on CAD lab

SECTION A

Module 1

Introduction : Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.

Orthographic projection of Points and Lines: Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of line. Inclination of lines with reference planes True length of line inclined to both the reference planes.

Module 2

Orthographic projection of Solids: Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.

Module 3

Sections of Solids: Sections of Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections. Also locating the section plane when the true shape of the section is given.

Development of Surfaces: Development of surfaces of the above solids and solids cut by different section planes. Also finding the shortest distance between two points on the surface.

Module 4

Isometric Projection: Isometric View and Projections of Prisms, Pyramids, Cone , Cylinder, Frustum of Pyramid, Frustum of Cone, Sphere, Hemisphere and their combinations.

Module 5

Perspective Projection: Perspective projection of Prisms and Pyramids with axis perpendicular to the ground plane, axis perpendicular to picture plane.

Conversion of Pictorial Views: Conversion of pictorial views into orthographic views.

SECTION B

(To be conducted in CAD Lab)

Introduction to Computer Aided Drawing: Role of CAD in design and development of new products, Advantages of CAD. Creating two dimensional drawing with dimensions using suitable software. (Minimum 2 exercises mandatory)

Introduction to Solid Modelling: Creating 3D models of various components using suitable modelling software. (Minimum 2 exercises mandatory)

Text Books

1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House Pvt. Ltd.
2. John, K.C. Engineering Graphics, Prentice Hall India Publishers.

Reference Books

1. Anilkumar, K.N., Engineering Graphics, Adhyuth narayan Publishers
2. Agrawal, B. And Agrawal, C.M., Engineering Drawing, Tata McGraw Hill Publishers.
3. Benjamin, J., Engineering Graphics, Pentex Publishers- 3rd Edition, 2017
4. Duff, J.M. and Ross, W.A., Engineering Design and Visualisation, Cengage Learning.
5. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., Engineering Graphics with AutoCAD, PHI.
6. Luzaddff, W.J. and Duff, J.M., Fundamentals of Engineering Drawing, PHI.
7. Varghese, P.I., Engineering Graphics, V I P Publishers
8. Venugopal, K., Engineering Drawing and Graphics, New Age International Publishers.

Course Contents and Lecture Schedule

No	SECTION A	No. of Hours
1	MODULE I	
1.1	Introduction to graphics, types of lines, Dimensioning	1
1.2	Concept of principle planes of projection, different quadrants, locating points on different quadrants	2
1.3	Projection of lines, inclined to one plane. Lines inclined to both planes, trapezoid method of solving problems on lines.	2
1.4	Problems on lines using trapezoid method	2
1.5	Line rotation method of solving, problems on line rotation method	2
2	MODULE II	
2.1	Introduction of different solids, Simple position plan and elevation of solids	2
2.2	Problems on views of solids inclined to one plane	2
2.3	Problems on views of solids inclined to both planes	2
2.4	Practice problems on solids inclined to both planes	2

3	MODULE III	
3.1	Introduction to section planes. AIP and AVP. Principle of locating cutting points and finding true shape	2
3.2	Problems on sections of different solids	2
3.3	Problems when the true shape is given	2
3.4	Principle of development of solids, sectioned solids	2
4	MODULE IV	
4.1	Principle of Isometric View and Projection, Isometric Scale. Problems on simple solids	2
4.2	Isometric problems on Frustum of solids, Sphere and Hemisphere	2
4.3	Problems on combination of different solids	2
5	MODULE V	
5.1	Introduction to perspective projection, different planes, station point etc. Perspective problems on pyramids	2
5.2	Perspective problems on prisms	2
5.3	Practice on conversion of pictorial views into orthographic views	2
	SECTION B (To be conducted in CAD lab)	
1	Introduction to CAD and software. Familiarising features of 2D software. Practice on making 2D drawings	2
2	Practice session on 2D drafting	2
3	Introduction to solid modelling and software	2
4	Practice session on 3D modelling	2

PHL 120	ENGINEERING PHYSICS LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	0	0	2	1	2019

Preamble: The aim of this course is to make the students gain practical knowledge to co-relate with the theoretical studies and to develop practical applications of engineering materials and use the principle in the right way to implement the modern technology.

Prerequisite: Higher secondary level Physics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop analytical/experimental skills and impart prerequisite hands on experience for engineering laboratories
CO 2	Understand the need for precise measurement practices for data recording
CO 3	Understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations
CO 4	Analyze the techniques and skills associated with modern scientific tools such as lasers and fiber optics
CO 5	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				3			1	2			1
CO 2	3				3			1	2			1
CO 3	3				3			1	2			1
CO 4	3				3			1	2			1
CO 5	3				3			1	2			1

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour**SYLLABUS****LIST OF EXPERIMENTS**

(Minimum 8 experiments should be completed)

1. CRO-Measurement of frequency and amplitude of wave forms
2. Measurement of strain using strain gauge and wheatstone bridge
3. LCR Circuit – Forced and damped harmonic oscillations
4. Melde's string apparatus- Measurement of frequency in the transverse and longitudinal mode
5. Wave length measurement of a monochromatic source of light using Newton's Rings method.
6. Determination of diameter of a thin wire or thickness of a thin strip of paper using airwedge method.
7. To measure the wavelength using a millimeter scale as a grating.
8. Measurement of wavelength of a source of light using grating.
9. Determination of dispersive power and resolving power of a plane transmission grating
10. Determination of the particle size of lycopodium powder
11. Determination of the wavelength of He-Ne laser or any standard laser using diffraction grating
12. Calculate the numerical aperture and study the losses that occur in optical fiber cable.
13. I-V characteristics of solar cell.
14. LED Characteristics.
15. Ultrasonic Diffractometer- Wavelength and velocity measurement of ultrasonic waves in a liquid
16. Deflection magnetometer-Moment of a magnet- Tan Aposition.

Reference books

1. S.L.Gupta and Dr.V.Kumar, "Practical physics with viva voice", Pragati Prakashan Publishers, Revised Edition, 2009
2. M.N.Avadhanulu, A.A.Dani and Pokely P.M, "Experiments in Engineering Physics", S.Chand&Co, 2008
3. S. K. Gupta, "Engineering physics practicals", Krishna Prakashan Pvt. Ltd., 2014
4. P. R. Sasikumar "Practical Physics", PHI Ltd., 2011.

HUN 101	LIFE SKILLS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		MNC	2	0	2	---	2019

Preamble: Life skills are those competencies that provide the means for an individual to be resourceful and positive while taking on life's vicissitudes. Development of one's personality by being aware of the self, connecting with others, reflecting on the abstract and the concrete, leading and generating change, and staying rooted in time-tested values and principles is being aimed at. This course is designed to enhance the employability and maximize the potential of the students by introducing them to the principles that underly personal and professional success, and help them acquire the skills needed to apply these principles in their lives and careers.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	Define and Identify different life skills required in personal and professional life
CO 2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.
CO 3	Explain the basic mechanics of effective communication and demonstrate these through presentations.
CO 4	Take part in group discussions
CO 5	Use appropriate thinking and problem solving techniques to solve new problems
CO 6	Understand the basics of teamwork and leadership

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2		1	2	2	1	3
CO 2									3			2
CO 3						1			1	3		
CO 4										3		1
CO 5		3	2	1								
CO 6						1			3			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation

Total Marks: 50

Attendance	: 10 marks
Regular assessment	: 15 marks
Series test (one test only, should include first three modules)	: 25 marks

Regular assessment

➤ **Group Discussion (Marks: 9)**

Create groups of about 6 students each and engage them on a GD on a suitable topic for about 20 minutes. Parameters to be used for evaluation are as follows:

- Communication Skills : 3 marks
- Subject Clarity : 2 marks
- Group Dynamics : 2 marks
- Behaviours & Mannerisms : 2 marks

➤ **Presentation Skills (Marks: 6)**

Identify a suitable topic and ask the students to prepare a presentation (preferably a power point presentation) for about 10 minutes. Parameters to be used for evaluation are as follows:

- Communication Skills : 2 marks
- Platform Skills : 2 marks
- Subject Clarity/Knowledge : 2 marks

End Semester Examination

Total Marks: 50

Time: 2 hrs.

Part A: Short answer question (25 marks)

There will be one question from each MODULE (five questions in total, five marks each). Each question should be written in about maximum of 400 words. Parameters to be used for evaluation are as follows:

- (i) Content Clarity/Subject Knowledge
- (ii) Presentation style
- (iii) Organization of content

Part B: Case Study (25 marks)

The students will be given a case study with questions at the end. The students have to analyze the case and answer the question at the end. Parameters to be used for evaluation are as follows:

- (i) Analyze the case situation
- (ii) Key players/characters of the case
- (iii) Identification of the problem (both major & minor if exists)
- (iv) Bring out alternatives
- (v) Analyze each alternative against the problem
- (vi) Choose the best alternative
- (vii) Implement as solution
- (viii) Conclusion

(ix) Answer the question at the end of the case

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List 'life skills' as identified by WHO
2. What do you mean by effective communication?
3. What are the essential life skills required by a professional?

Course Outcome 2 (CO2)

1. Identify an effective means to deal with workplace stress.
2. How can a student apply journaling to stress management?
3. What is the PATH method? Describe a situation where this method can be used effectively.

Course Outcome 3 (CO3):

1. Identify the communication network structure that can be observed in the given situations. Describe them.
 - (a) A group discussion on development.
 - (b) An address from the Principal regarding punctuality.
 - (c) A reporter interviewing a movie star.
 - (d) Discussing the answers of a test with a group of friends.
2. Elucidate the importance of non-verbal communication in making a presentation
3. Differentiate between kinesics, proxemics, and chronemics with examples.

Course Outcome 4 (CO4):

1. How can a participant conclude a group discussion effectively?
2. 'Listening skills are essential for effectively participating in a group discussion.' Do you agree? Substantiate your answer.

Course Outcome 5 (CO5):

1. Illustrate the creative thinking process with the help of a suitable example
2. Translate the following problem from verbal to graphic form and find the solution : *In a quiz, Ananth has 50 points more than Bimal, Chinmay has 60 points less than Ananth, and Dharini is 20 points ahead of Chinmay. What is the difference in points between Bimal and Dharini?*

3. List at least five ways in which the problem "How to increase profit?" can be redefined

Course Outcome 6 (CO6):

1. A group of engineers decided to brainstorm a design issue on a new product. Since no one wanted to disagree with the senior members, new ideas were not flowing freely. What group dynamics technique would you suggest to avoid this 'groupthink'? Explain the procedure.
2. "A group focuses on individual contribution, while a team must focus on synergy." Explain.
3. Identify the type of group formed / constituted in each of the given situations
 - a) A Police Inspector with subordinates reporting to him
 - b) An enquiry committee constituted to investigate a specific incident
 - c) The Accounts Department of a company
 - d) A group of book lovers who meet to talk about reading

Syllabus

Module 1

Overview of Life Skills: Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem solving, Effective communication, interpersonal relationship, coping with stress, coping with emotion.

Life skills for professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, helping others, leadership, motivation, self-motivation, and motivating others, personality development, IQ, EQ, and SQ

Module 2

Self-awareness: definition, need for self-awareness; Coping With Stress and Emotions, Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback.

Stress Management: Stress, reasons and effects, identifying stress, stress diaries, the four A's of stress management, techniques, Approaches: action-oriented, emotion-oriented, acceptance-oriented, resilience, Gratitude Training,

Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques.

Morals, Values and Ethics: Integrity, Civic Virtue, Respect for Others, Living Peacefully. Caring, Sharing, Honesty, Courage, Valuing Time, Time management, Co operation, Commitment, Empathy, Self-Confidence, Character, Spirituality, Avoiding Procrastination, Sense of Engineering Ethics.

Module 3

21st century skills: Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.

Steps in problem solving: Problem Solving Techniques, Six Thinking Hats, Mind Mapping, Forced Connections. Analytical Thinking, Numeric, symbolic, and graphic reasoning. Scientific temperament and Logical thinking.

Module 4

Group and Team Dynamics: Introduction to Groups: Composition, formation, Cycle, thinking, Clarifying expectations, Problem Solving, Consensus, Dynamics techniques, Group vs Team, Team Dynamics, Virtual Teams. Managing team performance and managing conflicts, Intrapreneurship.

Module 5

Leadership: Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions. Growing as a leader, turnaround leadership, managing diverse stakeholders, crisis management. Types of Leadership, Traits, Styles, VUCA Leadership, Levels of Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders.

Lab Activities

Verbal

Effective communication and Presentation skills.

Different kinds of communication; Flow of communication; Communication networks, Types of barriers; Miscommunication

Introduction to presentations and group discussions.

Learning styles: visual, aural, verbal, kinaesthetic, logical, social, solitary; Previewing, KWL table, active listening, REAP method

Note-taking skills: outlining, non-linear note-taking methods, Cornell notes, three column note taking.

Memory techniques: mnemonics, association, flashcards, keywords, outlines, spider diagrams and mind maps, spaced repetition.

Time management: auditing, identifying time wasters, managing distractions, calendars and checklists; Prioritizing - Goal setting, SMART goals; Productivity tools and apps, Pomodoro technique.

Non Verbal:

Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language, Communication in a multi cultural environment.

Reference Books

1. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
2. Barun K. Mitra, "Personality Development & Soft Skills", Oxford Publishers, Third impression, 2017.
3. ICT Academy of Kerala, "Life Skills for Engineers", McGraw Hill Education (India) Private Ltd., 2016.
4. Caruso, D. R. and Salovey P, "The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership", John Wiley & Sons, 2004.
5. Kalyana, "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd, 2015.
6. Larry James, "The First Book of Life Skills"; First Edition, Embassy Books, 2016.
7. Shalini Verma, "Development of Life Skills and Professional Practice"; First Edition; Sultan Chand (G/L) & Company, 2014.
8. Daniel Goleman, "Emotional Intelligence"; Bantam, 2006.
9. Remesh S., Vishnu R.G., "Life Skills for Engineers", Ridhima Publications, First Edition, 2016.
10. Butterfield Jeff, "Soft Skills for Everyone", Cengage Learning India Pvt Ltd; 1 edition, 2011.
11. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India; 6 edition, 2015.
12. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.



HUN 102	PROFESSIONAL COMMUNICATION	CATEGORY	L	T	P	CREDIT
		MNC	2	0	2	--

Preamble: Clear, precise, and effective communication has become a *sine qua non* in today's information-driven world given its interdependencies and seamless connectivity. Any aspiring professional cannot but master the key elements of such communication. The objective of this course is to equip students with the necessary skills to listen, read, write, and speak so as to comprehend and successfully convey any idea, technical or otherwise, as well as give them the necessary polish to become persuasive communicators.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop vocabulary and language skills relevant to engineering as a profession
CO 2	Analyze, interpret and effectively summarize a variety of textual content
CO 3	Create effective technical presentations
CO 4	Discuss a given technical/non-technical topic in a group setting and arrive at generalizations/consensus
CO 5	Identify drawbacks in listening patterns and apply listening techniques for specific needs
CO 6	Create professional and technical documents that are clear and adhering to all the necessary conventions

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1										3		2
CO 2										1		3
CO 3						1			1	3		
CO 4										3		1
CO 5		1							2	3		
CO 6	1					1			1	3		

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation

Total Marks: 50

Attendance : 10 marks

Regular assessment : 25 marks

Series test (one test only, should include verbal aptitude for placement and higher studies, this test will be conducted for 50 marks and reduced to 15) : 15 marks

Regular assessment

Project report presentation and Technical presentation through PPT : 7.5 marks

Listening Test : 5 marks

Group discussion/mock job interview : 7.5 marks

Resume submission : 5 marks

End Semester Examination

Total Marks: 50, Time: 2 hrs.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List down the ways in which gestures affect verbal communication.
2. Match the words and meanings
Ambiguous promotion
Bona fide referring to whole
Holistic not clear
Exaltation genuine
3. Expand the following Compound Nouns - a. Water supply. b. Object recognition. c. Steam turbine

Course Outcome 2 (CO2)

1. Read the passage below and prepare notes:

Mathematics, rightly viewed, possesses not only truth, but supreme beauty—a beauty cold and austere, like that of sculpture, without appeal to any part of our weaker nature, without the gorgeous trappings of painting or music, yet sublimely pure, and capable of a stern perfection such as only the greatest art can show. The true spirit of delight, the exaltation, the sense of being more than man, which is the touchstone of the highest excellence, is to be found in mathematics as surely as in poetry. What is best in mathematics deserves not merely to be learnt as a task, but to be assimilated as a part of daily thought, and brought again and again before the mind with ever-renewed encouragement. Real life is, to most men, a long second-best, a perpetual compromise between the ideal and the possible; but the world of pure reason knows no compromise, no practical limitations, no barrier to the creative activity embodying in splendid edifices the passionate aspiration after the perfect from which all great work springs. Remote from human passions, remote even from the pitiful facts of nature, the generations have gradually created an ordered cosmos, where pure thought can dwell as in its natural home, and where one, at least, of our nobler impulses can escape from the dreary exile of the actual world.

So little, however, have mathematicians aimed at beauty, that hardly anything in their work has had this conscious purpose. Much, owing to irrepressible instincts, which were better than avowed

beliefs, has been moulded by an unconscious taste; but much also has been spoilt by false notions of what was fitting. The characteristic excellence of mathematics is only to be found where the reasoning is rigidly logical: the rules of logic are to mathematics what those of structure are to architecture. In the most beautiful work, a chain of argument is presented in which every link is important on its own account, in which there is an air of ease and lucidity throughout, and the premises achieve more than would have been thought possible, by means which appear natural and inevitable. Literature embodies what is general in particular circumstances whose universal significance shines through their individual dress; but mathematics endeavours to present whatever is most general in its purity, without any irrelevant trappings.

How should the teaching of mathematics be conducted so as to communicate to the learner as much as possible of this high ideal? Here experience must, in a great measure, be our guide; but some maxims may result from our consideration of the ultimate purpose to be achieved.

- From "On the teaching of mathematics" – Bertrand Russell

2. Enumerate the advantages and disadvantages of speed reading. Discuss how it can impact comprehension.

Course Outcome 3(CO3):

1. What are the key elements of a successful presentation?
2. Elucidate the importance of non-verbal communication in making a presentation
3. List out the key components in a technical presentation.

Course Outcome 4 (CO4):

1. Discuss: 'In today's world, being a good listener is more important than being a good Speaker.'
2. Listen to a video/live group discussion on a particular topic, and prepare a brief summary of the proceedings.
3. List the do's and don'ts in a group discussion.

Course Outcome 5 (CO5):

1. Watch a movie clip and write the subtitles for the dialogue.
2. What do you mean by barriers to effective listening? List ways to overcome each of these.
3. What are the different types of interviews? How are listening skills particularly important in Skype/telephonic interviews?

Course Outcome 6 (CO6):

1. Explain the basic structure of a technical report.
2. You have been offered an internship in a much sought-after aerospace company and are very excited about it. However, the dates clash with your series tests. Write a letter to the Manager – University Relations of the company asking them if they can change the dates to coincide with your vacation.
3. You work in a well-reputed aerospace company as Manager – University Relations. You are in charge of offering internships. A student has sent you a letter requesting you to change the dates allotted to him since he has series exams at that time. But there are no vacancies available during the period he has requested for. Compose an e-mail informing him of this and suggest that he try to arrange the matter with his college.

Syllabus

Module 1

Use of language in communication: Significance of technical communication Vocabulary Development: technical vocabulary, vocabulary used in formal letters/emails and reports, sequence words, misspelled words, compound words, finding suitable synonyms, paraphrasing, verbal analogies. Language Development: subject-verb agreement, personal passive voice, numerical adjectives, embedded sentences, clauses, conditionals, reported speech, active/passive voice.

Technology-based communication: Effective email messages, slide presentations, editing skills using software. Modern day research and study skills: search engines, repositories, forums such as Git Hub, Stack Exchange, OSS communities (MOOC, SWAYAM, NPTEL), and Quora; Plagiarism

Module 2

Reading, Comprehension, and Summarizing: Reading styles, speed, valuation, critical reading, reading and comprehending shorter and longer technical articles from journals, newspapers, identifying the various transitions in a text, SQ3R method, PQRS method, speed reading. Comprehension: techniques, understanding textbooks, marking and underlining, Note-taking: recognizing non-verbal cues.

Module 3

Oral Presentation: Voice modulation, tone, describing a process, Presentation Skills: Oral presentation and public speaking skills, business presentations, Preparation: organizing the material, self-introduction, introducing the topic, answering questions, individual presentation practice, presenting visuals effectively.

Debate and Group Discussions: introduction to Group Discussion (GD), differences between GD and debate; participating GD, understanding GD, brainstorming the topic, questioning and clarifying, GD strategies, activities to improve GD skills

Module 4

Listening and Interview Skills Listening: Active and Passive listening, listening: for general content, to fill up information, intensive listening, for specific information, to answer, and to understand. Developing effective listening skills, barriers to effective listening, listening to longer technical talks, listening to classroom lectures, talks on engineering /technology, listening to documentaries and making notes, TED talks.

Interview Skills: types of interviews, successful interviews, interview etiquette, dress code, body language, telephone/online (skype) interviews, one-to-one interview & panel interview, FAQs related to job interviews

Module 5

Formal writing: Technical Writing: differences between technical and literary style. Letter Writing (formal, informal and semi formal), Job applications, Minute preparation, CV preparation (differences between Bio-Data, CV and Resume), and Reports. Elements of style, Common Errors in Writing: describing a process, use of sequence words, Statements of Purpose, Instructions, Checklists.

Analytical and issue-based Essays and Report Writing: basics of report writing; Referencing Style (IEEE Format), structure of a report; types of reports, references, bibliography.

Lab Activities

Written: Letter writing, CV writing, Attending a meeting and Minute Preparation, Vocabulary Building

Spoken: Phonetics, MMFS (Multimedia Feedback System), Mirroring, Elevator Pitch, telephone etiquette, qualities of a good presentation with emphasis on body language and use of visual aids.

Listening: Exercises based on audio materials like radio and podcasts. Listening to Song. practice and exercises.

Reading: Speed Reading, Reading with the help of Audio Visual Aids, Reading Comprehension Skills

Mock interview and Debate/Group Discussion: concepts, types, Do's and don'ts- intensive practice

Reference Books

1. English for Engineers and Technologists (Combined edition, Vol. 1 and 2), Orient Blackswan 2010.
2. Meenakshi Raman and Sangeetha Sharma, "Technical Communication: Principles and Practice", 2nd Edition, Oxford University Press, 2011
3. Stephen E. Lucas, "The Art of Public Speaking", 10th Edition; McGraw Hill Education, 2012.
4. Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw Hill Education, 2017.
5. William Strunk Jr. & E.B. White, "The Elements of Style", 4th Edition, Pearson, 1999.
6. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Wiley. New York, 2004.
7. Goodheart-Willcox, "Professional Communication", First Edition , 2017.
8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 edition, 2015.
9. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.
10. Anand Ganguly, "Success in Interview", RPH, 5th Edition, 2016.
11. Raman Sharma, "Technical Communications", Oxford Publication, London, 2004.



SEMESTER -3

MATHEMATICS

MATHEMATICS – Third Semester B. Tech

(For all branches except Computer Science and Information Technology)

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MAT201	PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS	BASIC SCIENCE COURSE	3	1	0	4

Preamble: This course introduces basic ideas of partial differential equations which are widely used in the modelling and analysis of a wide range of physical phenomena and has got application across all branches of engineering. To understand the basic theory of functions of a complex variable, residue integration and conformal transformation.

Prerequisite: A basic course in partial differentiation and complex numbers.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the concept and the solution of partial differential equation.
CO 2	Analyse and solve one dimensional wave equation and heat equation.
CO 3	Understand complex functions, its continuity differentiability with the use of Cauchy-Riemann equations.
CO 4	Evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula, understand the series expansion of analytic function
CO 5	Understand the series expansion of complex function about a singularity and Apply residue theorem to compute several kinds of real integrals.

Mapping of course outcomes with program outcomes

PO's	Broad area
PO 1	Engineering Knowledge
PO 2	Problem Analysis
PO 3	Design/Development of solutions
PO 4	Conduct investigations of complex problems
PO 5	Modern tool usage
PO 6	The Engineer and Society
PO 7	Environment and Sustainability
PO 8	Ethics
PO 9	Individual and team work

PO 10	Communication
PO 11	Project Management and Finance
PO 12	Life long learning

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	1				2		2
CO 2	3	3	3	3	2	1				2		2
CO 3	3	3	3	3	2	1				2		2
CO 4	3	3	3	3	2	1				2		2
CO 5	3	3	3	3	2	1				2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests(%)		End Semester Examination(%)
	1	2	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	10	10	10
Create			

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions.

Course Outcome 1 (CO1):

1. Form the partial differential equation given $z = xf(x) + ye^2$
2. What is the difference between complete integral and singular integral of a partial differential equation
3. Solve $3z = xp + yq$
4. Solve $(p^2 + q^2)y = qz$
5. Solve $u_x - 2u_t = u$ by the method of separation of variables

Course Outcome 2 (CO2):

1. Write any three assumptions in deriving one dimensional wave equations
2. Derive one Dimensional heat equation
3. Obtain a general solution for the one dimensional heat equation $\frac{\partial u}{\partial t} = \frac{c^2}{a^2} \frac{\partial^2 u}{\partial x^2}$
4. A tightly stretched flexible string has its ends fixed at $x = 0$ and $x = l$. At $t = 0$, the string is given a shape defined by $f(x) = \mu x(l - x)$ where μ is a constant
5. Find the temperature $u(x, t)$ in a bar which is perfectly insulated laterally whose ends are kept at 0°C and whose initial temperature (in degree Celsius) is $f(x) = x(10 - x)$ given that its length is 10 cm and specific heat is $0.056 \text{ cal/gram deg}$

Course Outcome 3 (CO3):

1. Separate the real and imaginary parts of $f(z) = \frac{1}{1+z}$
2. Check whether the function $f(z) = \frac{\text{Re}(z)^2}{|z|}$ is continuous at $z = 0$ given $f(0) = 0$
3. Determine a and b so that function $u = e^{-\text{Re}(z)} \cos y$ is harmonic. Find its harmonic conjugate.
4. Find the fixed points of $w = \frac{i}{2z-1}$
5. Find the image of $|z| \leq \frac{1}{2}$ under $w = z^2$

Course Outcome 4 (CO4):

1. Find the value of $\int_C \exp(z^2) dz$ where C is $|z| = 1$
2. Integrate the function $\int_C \frac{\sin z}{z+4iz} dz$ where C is $|z - 4 - 2i| = 6.5$
3. Evaluate $\int_C \frac{dz}{(z-4)^3}$ where C is $|z| = 1$
4. Find the Maclaurin series expansion of $f(z) = \frac{i}{1-z}$ and state the region of convergence.
5. Find the image of $|z| = 2$ under the mapping $w = z + \frac{1}{z}$

Course Outcome 5 (CO5):

1. Determine the singularity of $\exp\left(\frac{1}{z}\right)$
2. Find the Laurent series of $\frac{1}{z^2(z-i)}$ about $z = i$
3. Find the residues of $f(z) = \frac{50z}{z^3 + 2z^2 - 7z + 4}$
4. Evaluate $\int_C \tan 2\pi z dz$ where C is $|z - 0.2| = 0.2$
5. Evaluate $\int_0^{\pi} \frac{d\theta}{\sqrt{2-\cos \theta}}$

Syllabus

Module 1 (Partial Differential Equations) (8 hours)

(Text 1-Relevant portions of sections 17.1, 17.2, 17.3, 17.4, 17.5, 17.7, 18.1, 18.2)

Partial differential equations, Formation of partial differential equations –elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equations, Equations solvable by direct integration, Linear equations of the first order-Lagrange's linear equation, Non-linear equations of the first order -Charpit's method, Solution of equation by method of separation of variables.

Module 2 (Applications of Partial Differential Equations) (10 hours)

(Text 1-Relevant portions of sections 18.3, 18.4, 18.5)

One dimensional wave equation- vibrations of a stretched string, derivation, solution of the wave equation using method of separation of variables, D'Alembert's solution of the wave equation, One dimensional heat equation, derivation, solution of the heat equation

Module 3 (Complex Variable – Differentiation) (9 hours)

(Text 2: Relevant portions of sections 13.3, 13.4, 17.1, 17.2, 17.4)

Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugate, Conformal mappings- mappings $w = z^2$, $w = e^z$. Linear fractional transformation $w = \frac{1}{z}$, fixed points, Transformation $w = \sin z$

(From sections 17.1, 17.2 and 17.4 only mappings $w = z^2$, $w = e^z$, $w = \frac{1}{z}$, $w = \sin z$ and problems based on these transformation need to be discussed)

Module 4 (Complex Variable – Integration) (9 hours)

(Text 2- Relevant topics from sections 14.1, 14.2, 14.3, 14.4, 15.4)

Complex integration, Line integrals in the complex plane, Basic properties, First evaluation method-indefinite integration and substitution of limit, second evaluation method-use of a representation of a path, Contour integrals, Cauchy integral theorem (without proof) on simply connected domain, Cauchy integral theorem (without proof) on multiply connected domain Cauchy Integral formula (without proof), Cauchy Integral formula for derivatives of an analytic function, Taylor's series and Maclaurin series.,

Module 5 (Complex Variable – Residue Integration) (9 hours)

(Text 2- Relevant topics from sections 16.1, 16.2, 16.3, 16.4)

Laurent's series(without proof), zeros of analytic functions, singularities, poles, removable singularities, essential singularities, Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral using residue theorem, Residue integration of real integrals – integrals of rational functions of $\cos\theta$ and $\sin\theta$, integrals of improper integrals of the form

MATHEMATICS

$\int_{-\infty}^{\infty} f(x) dx$ with no poles on the real axis. ($\int_A^B f(x) dx$ whose integrand become infinite at a point in the interval of integration is excluded from the syllabus),

Textbooks:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2016.

References:

1. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition, 2012

Assignments

Assignment: Assignment must include applications of the above theory in the concerned engineering branches

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Partial Differential Equations	
1.1	Partial differential equations, Formation of partial differential equations –elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equations, Equations solvable by direct integration,	3
1.2	Linear equations of the first order- Lagrange's linear equation, Non-linear equations of the first order - Charpit's method	3
1.3	Boundary value problems, Method of separation of variables.	2
2	Applications of Partial Differential Equations	
2.1	One dimensional wave equation- vibrations of a stretched string, derivation,	1
2.2	Solution of wave equation using method of separation of variables, Fourier series solution of boundary value problems involving wave equation, D'Alembert's solution of the wave equation	4
2.3	One dimensional heat equation, derivation,	1
2.4	Solution of the heat equation, using method of separation of variables, Fourier series solutions of boundary value problems involving heat equation	4

3	Complex Variable – Differentiation	
3.1	Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations,	4
3.2	harmonic functions, finding harmonic conjugate,	2
3.3	Conformal mappings- mappings of $w = z^2$, $w = e^z$, $w = \frac{1}{z}$, $w = \sin z$.	3
4	Complex Variable – Integration	
4.1	Complex integration, Line integrals in the complex plane, Basic properties, First evaluation method, second evaluation method, use of representation of a path	4
4.2	Contour integrals, Cauchy integral theorem (without proof) on simply connected domain, on multiply connected domain(without proof). Cauchy Integral formula (without proof),	2
4.3	Cauchy Integral formula for derivatives of an analytic function,	2
4.3	Taylor's series and Maclaurin series.	1
5	Complex Variable – Residue Integration	
5.1	Laurent's series(without proof)	2
5.2	zeros of analytic functions, singularities, poles, removable singularities, essential singularities, Residues,	2
5.3	Cauchy Residue theorem (without proof), Evaluation of definite integral using residue theorem	2
5.4	Residue integration of real integrals – integrals of rational functions of $\cos\theta$ and $\sin\theta$, integrals of improper integrals of the form $\int_{-\infty}^{\infty} f(x)dx$ with no poles on the real axis. ($\int_A^B f(x)dx$ whose integrand become infinite at a point in the interval of integration is excluded from the syllabus),	3

Model Question Paper

(For all branches except Computer Science and Information Technology)

(2019 Scheme)

Reg No:

Name:

APJ ABDULKALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH. DEGREE EXAMINATION

(MONTH & YEAR)

Course Code:

Course Name: PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS

MAX.MARKS: 100

DURATION: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1. Derive a partial differential equation from the relation $z = f(x + at) + g(x - at)$
2. Solve $\frac{\partial^2 z}{\partial x \partial y} = x^2 y$
3. State any three assumptions in deriving the one dimensional wave equation
4. What are the possible solutions of one-dimensional heat equation?
5. If $f(z) = u + iv$ is analytic, then show that u and v are harmonic functions.
6. Check whether $f(z) = z$ is analytic or not.
7. Evaluate $\int_c \tan z \, dz$ where c is the unit circle.
8. Find the Taylor's series of $f(z) = \frac{1}{z}$ about $z = 2$.
9. What type of singularity have the function $f(z) = \frac{1}{\cos z - \sin z}$
10. Find the residue of $\frac{e^z}{z^3}$ at its pole.

PART B

Answer any one full question from each module, each question carries 14 marks.

Module-I

11. (a) Solve $x(y - z)p + y(z - x)q = z(x - y)$
(b) Use Charpit's methods to solve $q + xp = p^2$
12. (a) Find the differential equation of all spheres of fixed radius having their centers in the xy -plane.

MATHEMATICS

- (b) Using the method of separation of variables, solve $\frac{\partial u}{\partial x} = 2 \frac{\partial u}{\partial t}$, where $u(x, 0) = 6e^{-3x}$.

Module – II

13. (a) Derive the solution of one dimensional wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ with zero boundary conditions and with initial conditions $u(x, 0) = f(x)$ and $\left(\frac{\partial u}{\partial t}\right)_{t=0} = 0$.
- (b) A homogeneous rod of conducting material of length 100 cm has its ends kept at zero temperature and the temperature initially is $u(x, 0) = \begin{cases} x, & 0 \leq x \leq 50 \\ 100 - x, & 50 \leq x \leq 100 \end{cases}$. Find the temperature $u(x, t)$ at any time.
14. (a) A tightly stretched string of length l with fixed ends is initially in equilibrium position. It is set vibrating by giving each point a velocity $v_0 \sin^3(\pi x/l)$. Find the displacement of the string at any time.
- (b) An insulated rod of length l has its ends A and B are maintained at 0°C and 100°C respectively under steady state condition prevails. If the temperature at B is suddenly reduced to 0°C and maintained at 0°C , Find the temperature at a distance x from A at time t .

Module-III

15. (a) Show that $f(z) = e^z$ is analytic for all z . Find its derivative.
- (b) Find the image of $|z - 2i| = 2$ under the transformation $w = \frac{1}{z}$.
16. (a) Prove that the function $u(x, y) = x^3 - 3xy^2 - 5y$ is harmonic everywhere. Find its harmonic conjugate.
- (b) Find the image of the infinite stripe $0 \leq y \leq \pi$ under the transformation $w = e^z$.

Module-IV

17. (a) Evaluate $\int_0^{2+i} (z)^2 dz$, along the real axis to 2 and then vertically to $2 + i$.
- (b) Using Cauchy's integral formula evaluate $\int \frac{5z+7}{z^2+2z-3} dz$, where C is $|z - 2| = 2$.
18. (a) Evaluate $\int_C \frac{\sin^2 z}{(z-\frac{\pi}{6})^3} dz$, where C is $|z| = 1$.
- (b) Expand $\frac{1}{(z-1)(z-2)}$ in the region $|z| < 1$.

Module- V

19. (a) Expand $f(z) = \frac{z^2-1}{z^2-5z+6}$ in $2 < |z| < 3$ as a Laurent's series.
- (b) Using contour integration evaluate $\int_0^{2\pi} \frac{d\theta}{2+\cos \theta}$.
20. (a) Use residue theorem to evaluate $\int_C \frac{e^{i\pi z}}{z^2+4} dz$ where C is $|z| = 3$.
- (b) Apply calculus of residues to evaluate $\int_{-\infty}^{\infty} \frac{1}{(x^2+1)^3} dx$.

AUTOMOBILE ENGINEERING

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MET201	MECHANICS OF SOLIDS	PCC	3	1	0	4

Preamble:

This course helps the students to understand the concept of stress and strain in different types of structure/machine under various loading conditions. The course also covers simple and compound stresses due to forces, stresses and deflection in beams due to bending, torsion in circular section, strain energy, different theories of failure, stress in thin cylinder thick cylinder and spheres due to external and internal pressure.

Prerequisite: EST100 ENGINEERING MECHANICS

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Determine the stresses, strains and displacements of structures by tensorial and graphical (Mohr's circle) approaches
CO 2	Analyse the strength of materials using stress-strain relationships for structural and thermal loading
CO 3	Perform basic design of shafts subjected to torsional loading and analyse beams subjected to bending moments
CO 4	Determine the deformation of structures subjected to various loading conditions using strain energy methods
CO 5	Analyse column buckling and appreciate the theories of failures and its relevance in engineering design

Mapping of course outcomes with program outcomes

[illegible]

AUTOMOBILE ENGINEERING

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	20	20	30
Apply	20	20	50
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module and having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have a maximum of 2 subdivisions.

AUTOMOBILE ENGINEERING

COURSE LEVEL ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Determine the resultant traction at a point in a plane using the stress tensor.
2. Evaluate the principal stresses, principal strains and their directions from a given state of stress or strain.
3. Write the stress tensor and strain tensor.

Course Outcome 2 (CO2)

1. Write the generalized Hooke's law for stress-strain relations.
2. Estimate the state of strain from a given state of stress.
3. Analyse the strength of a structure subjected to thermal loading.

Course Outcome 3(CO3):

1. Design a shaft to transmit power and torque.
2. Draw the shear force and bending moment diagrams.
3. Determine the bending stress on a beam subjected to pure bending.

Course Outcome 4 (CO4):

1. Apply strain energy method to estimate the deformation of a structure.
2. Use strain energy method to calculate deformations for multiple loads.
3. Use strain energy method to estimate the loads acting on a structure for a maximum deflection.

Course Outcome 5 (CO5):

1. Analyse a column for buckling load.
2. Use Rankine formula to determine the crippling load of columns.
3. A bolt is subjected to a direct tensile load of 20 kN and a shear load of 15 kN. Suggest suitable size of this bolt according to various theories of elastic failure, if the yield stress in simple tension is 360 MPa. A factor of safety 2 should be used. Assume Poisson's ratio as 0.3.

AUTOMOBILE ENGINEERING

SYLLABUS

Module 1

Deformation behaviour of elastic solids in equilibrium under the action of a system of forces, method of sections. Stress vectors on Cartesian coordinate planes passing through a point, stress at a point in the form of a matrix. Equality of cross shear, Cauchy's equation. Displacement, gradient of displacement, Cartesian strain matrix, strain- displacement relations (small-strain only), Simple problems to find strain matrix. Stress tensor and strain tensor for plane stress and plane strain conditions. Principal planes and principal stress, meaning of stress invariants, maximum shear stress. Mohr's circle for 2D case.

Module 2

Stress-strain diagram, Stress-Strain curves of Ductile and Brittle Materials, Poisson's ratio. Constitutive equations-generalized Hooke's law, equations for linear elastic isotropic solids in terms of Young's Modulus and Poisson's ratio, Hooke's law for Plane stress and plane strain conditions. Relations between elastic constants E , G , ν and K (derivation not required). Calculation of stress, strain and change in length in axially loaded members with single and composite materials, Effects of thermal loading – thermal stress and thermal strain. Thermal stress on a prismatic bar held between fixed supports.

Module 3

Torsional deformation of circular shafts, assumptions for shafts subjected to torsion within elastic deformation range, derivation of torsion formula Torsional rigidity, Polar moment of inertia, basic design of transmission shafts. Simple problems to estimate the stress in solid and hollow shafts. Shear force and bending moment diagrams for cantilever and simply supported beams. Differential equations between load, shear force and bending moment. Normal and shear stress in beams: Derivation of flexural formula, section modulus, flexural rigidity, numerical problems to evaluate bending stress, economic sections. Shear stress formula for beams: (Derivation not required), shear stress distribution for a rectangular section.

Module 4

Deflection of beams using Macauley's method. Elastic strain energy and Complementary strain energy. Elastic strain energy for axial loading, transverse shear, bending and torsional loads. Expressions for strain energy in terms of load, geometry and material properties of the body for axial, shearing, bending and torsional loads. Castigliano's second theorem, reciprocal relation (Proof not required for Castigliano's second theorem, reciprocal relation). Simple problems to find the deflections using Castigliano's theorem.

Module 5

Fundamentals of buckling and stability, critical load, equilibrium diagram for buckling of an idealized structure. Buckling of columns with pinned ends, Euler's buckling theory for long columns. Critical stress, slenderness ratio, Rankine's formula for short columns. Introduction to Theories of Failure, Rankine's theory for maximum normal stress, Guest's theory for maximum shear stress, Saint-Venant's theory for maximum normal strain, Hencky-von Mises theory for maximum distortion energy, Haigh's theory for maximum strain energy.

Text Books

1. Mechanics of materials in S.I. Units, R .C. Hibbeler, Pearson Higher Education 2018
2. Advanced Mechanics of Solids, L. S. Srinath, McGraw Hill Education

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3. Design of Machine Elements, V. B Bhandari, McGraw Hill Education

Reference Books

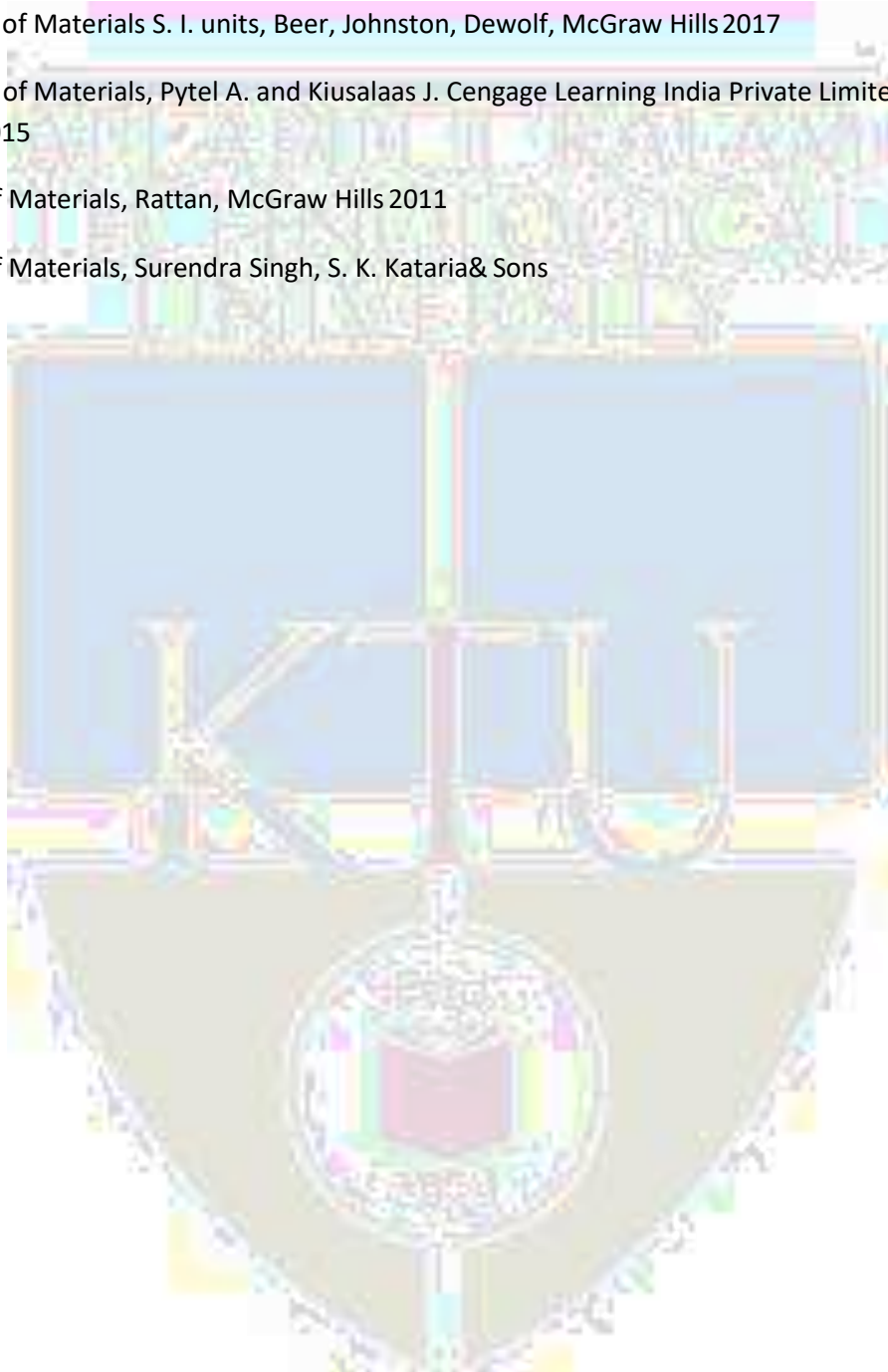
1. Engineering Mechanics of Solids, Popov E., PHI 2002

2. Mechanics of Materials S. I. units, Beer, Johnston, Dewolf, McGraw Hills 2017

3. Mechanics of Materials, Pytel A. and Kiusalaas J. Cengage Learning India Private Limited, 2nd Edition, 2015

4. Strength of Materials, Rattan, McGraw Hills 2011

5. Strength of Materials, Surendra Singh, S. K. Kataria & Sons



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COURSE PLAN

No	Topic	No of lectures
1	Module 1: Stress and Strain Analysis	9 hours
1.1	Describe the deformation behaviour of elastic solids in equilibrium under the action of a system of forces. Describe method of sections to illustrate stress as resisting force per unit area. Stress vectors on Cartesian coordinate planes passing through a point and writing stress at a point in the form of a matrix.	2 hr
1.2	Equality of cross shear (Derivation not required). Write Cauchy's equation (Derivation not required), Find resultant stress, Normal and shear stress on a plane given stress tensor and direction cosines (no questions for finding direction cosines).	2 hr
1.3	Displacement, gradient of displacement, Cartesian strain matrix, Write strain-displacement relations (small-strain only), Simple problems to find strain matrix given displacement field (2D and 3D), write stress tensor and strain tensor for Plane stress and plane strain conditions.	1 hr
1.4	Concepts of principal planes and principal stress, characteristic equation of stress matrix and evaluation of principal stresses and principal planes as an eigen value problem, meaning of stress invariants, maximum shear stress	2 hrs
1.5	Mohr's circle for 2D case: find principal stress, planes, stress on an arbitrary plane, maximum shear stress graphically using Mohr's circle	2 hrs
2	Module 2: Stress - Strain Relationships	9 hours
2.1	Stress-strain diagram, Stress-Strain curves of Ductile and Brittle Materials, Poisson's ratio	1 hr
2.2	Constitutive equations-generalized Hooke's law, equations for linear elastic isotropic solids in terms of Young's Modulus and Poisson's ratio (3D). Hooke's law for Plane stress and plane strain conditions Relations between elastic constants E, G, ν and K (derivation not required), Numerical problems	2 hrs
2.3	Calculation of stress, strain and change in length in axially loaded members with single and composite materials, Effects of thermal loading – thermal stress and thermal strain. Thermal stress on a prismatic bar held between fixed supports.	2 hrs
2.4	Numerical problems for axially loaded members	4 hrs
3	Module 3: Torsion of circular shafts, Shear Force-Bending Moment Diagrams and Pure bending	9 hours
3.1	Torsional deformation of circular shafts, assumptions for shafts subjected to torsion within elastic deformation range, derivation of torsion formula	1 hr
3.2	Torsional rigidity, Polar moment of inertia, comparison of solid and hollow shaft. Simple problems to estimate the stress in solid and hollow shafts	1 hr
3.3	Numerical problems for basic design of circular shafts subjected to externally applied torques	1 hr
3.4	Shear force and bending moment diagrams for cantilever and simply	2 hrs

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	supported beams subjected to point load, moment, UDL and linearly varying load	
3.5	Differential equations between load, shear force and bending moment.	1 hr
3.6	Normal and shear stress in beams: Derivation of flexural formula, section modulus, flexural rigidity, numerical problems to evaluate bending stress, economic sections Shear stress formula for beams: (Derivation not required), numerical problem to find shear stress distribution for rectangular section	3 hrs
4	Module 4: Deflection of beams, Strain energy	8 hours
4.1	Deflection of cantilever and simply supported beams subjected to point load, moment and UDL using Macauley's method (procedure and problems with multiple loads)	2 hrs
4.2	Linear elastic loading, elastic strain energy and Complementary strain energy. Elastic strain energy for axial loading, transverse shear, bending and torsional loads (short derivations in terms of loads and deflections).	2 hr
4.3	Expressions for strain energy in terms of load, geometry and material properties of the body for axial, shearing, bending and torsional loads. Simple problems to solve elastic deformations	2 hrs
4.4	Castigliano's second theorem to find displacements, reciprocal relation, (Proof not required for Castigliano's second theorem and reciprocal relation).	1 hr
4.5	Simple problems to find the deflections using Castigliano's theorem	1 hr
5	Module 5: Buckling of Columns, Theories of Failure	8 hours
5.1	Fundamentals of bucking and stability, critical load, Euler's formula for long columns, assumptions and limitations, effect of end conditions(derivation only for pinned ends), equivalent length	2 hr
5.2	Critical stress, slenderness ratio, Rankine's formula for short columns, Problems	3 hr
5.3	Introduction to Theories of Failure. Rankine's theory for maximum normal stress, Guest's theory for maximum shear stress, Saint-Venant's theory for maximum normal strain	2 hr
5.4	Hencky-von Mises theory for maximum distortion energy, Haigh's theory for maximum strain energy	1 hr

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MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION

Course Code : MET201

Course Name : MECHANICS OF SOLIDS

Max. Marks : 100

Duration : 3 Hours

PART – A

(ANSWER ALL QUESTIONS, EACH QUESTION CARRIES 3 MARKS)

1. Express the stress invariants in terms of Cartesian components of stress and principal stress.
2. Write down the Cauchy's strain displacement relationships.
3. Distinguish between the states of plane stress and plane strain.
4. Explain the generalized Hooke's law for a Linear elastic isotropic material.
5. List any three important assumptions in the theory of torsion.
6. Write the significance of flexural rigidity and section modulus in the analysis of beams.
7. Discuss reciprocal relation for multiple loads on a structure.
8. Express the strain energy for a cantilever beam subjected to a transverse point load at free end.
9. Discuss Saint-Venant's theory of failure.
10. Explain the term 'critical load' with reference to the buckling of slender columns.

PART – B

(ANSWER ONE FULL QUESTION FROM EACH MODULE)

MODULE – 1

11. a) The state of stress at a point is given by $\sigma_{xx} = 12.31$ MPa, $\sigma_{yy} = 8.96$ MPa, $\sigma_{zz} = 4.34$ MPa, $\tau_{xy} = 4.2$ MPa, $\tau_{yz} = 5.27$ MPa, $\tau_{xz} = 0.84$ MPa. Determine the principal stresses. (7 marks)

b) The displacement field for a body is given by $\mathbf{u} = (x^2 + y)\mathbf{i} + (3 + z)\mathbf{j} + (x^2 + 2y)\mathbf{k}$. What is the deformed position of a point originally at (3,1,-2)? Write the strain tensor at the point (-3,-1,2).

(7 marks)

OR

12. a) The state of plane stress at a point is given by $\sigma_{xx} = 40$ MPa, $\sigma_{yy} = 20$ MPa and $\tau_{xy} = 16$ MPa. Using Mohr's circle determine the i) principal stresses and principal planes and ii) maximum shear stress. (7 marks)

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b) The state of stress at a point is given below. Find the resultant stress vector acting on a plane with direction cosines $n_x=0.47$, $n_y=0.82$ and $n_z=0.33$. Find the normal and tangential stresses acting on this plane. (7 marks)

$$\sigma_{ij} = \begin{bmatrix} 10 & 5 & -10 \\ 5 & 20 & -15 \\ -10 & -15 & -10 \end{bmatrix} \text{ MPa}$$

MODULE – 2

13. a) Calculate Modulus of Rigidity and Young's Modulus of a cylindrical bar of diameter 30 mm and of 1.5 m length if the longitudinal strain in a bar during a tensile stress is four times the lateral strain. Find the change in volume when the bar is subjected to a hydrostatic pressure of 100 N/mm². Take $E = 10^5$ N/mm (9 marks)

b) A straight bar 450 mm long is 40 mm in diameter for the first 250 mm length and 20 mm diameter for the remaining length. If the bar is subjected to an axial pull of 15 kN find the maximum axial stress produced and the total extension of the bar. Take $E = 2 \times 10^5$ N/mm² (5 marks)

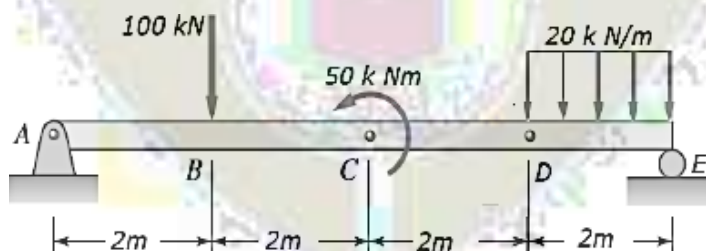
OR

14. a) A brass bar 20mm diameter is enclosed in a steel tube of 25mm internal diameter and 50mm external diameter. Both bar and tube is of same length and fastened rigidly at their ends. The composite bar is free of stress at 20°C. To what temperature the assembly must be heated to generate a compressive stress of 48MPa in brass bar? Also determine the stress in steel tube. $E_{\text{steel}} = 200\text{GPa}$ and $E_{\text{brass}} = 84\text{GPa}$, $\alpha_{\text{steel}} = 12 \times 10^{-6} / ^\circ\text{C}$ and $\alpha_{\text{brass}} = 18 \times 10^{-6} / ^\circ\text{C}$. (9 marks)

b) Draw the stress-strain diagram for a ductile material and explain the salient points. (5 marks)

MODULE – 3

15. a) Draw shear force and bending moment diagram for the beam given in the figure. (9 marks)

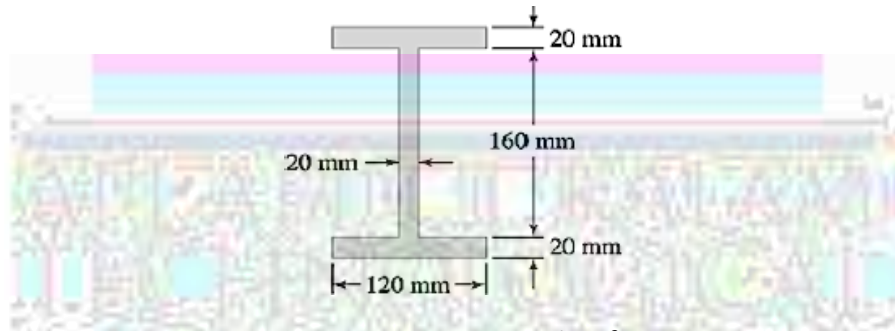


b) Compare the strength of a hollow shaft of diameter ratio 0.75 to that of a solid shaft by considering the permissible shear stress. Both the shafts are of same material, of same length and weight. (5 marks)

OR

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16. a) A simply supported beam of span of 10 m carries a UDL of 40 kN/m. The cross section is of I shape as given below. Calculate the maximum stress produced due to bending and plot the bending stress distribution. (9 marks)



- b) The shear stress of a solid shaft is not to exceed 40 N/mm^2 when the power transmitted is 20 kW at 200 rpm. Determine the minimum diameter of the shaft. (5 marks)

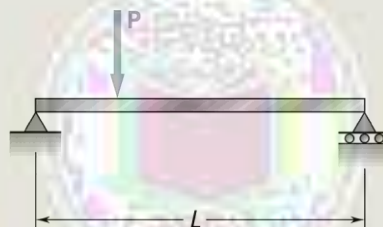
MODULE – 4

17. a) A horizontal girder of steel having uniform section is 14 m long and is simply supported at its ends. It carries concentrated loads of 120 kN and 80 kN at two points 3 m and 4.5 m from the two ends respectively. Moment of inertia for the section of the girder is $16 \times 10^8 \text{ mm}^4$ and $E_s = 210 \text{ kN/mm}^2$. Calculate the deflection of the girder at points under the two loads and maximum deflection using Macaulay's method. (8 marks)

- b) Derive the expressions for elastic strain energy in terms of applied load/moment and material property for the cases of a) Axial force b) Bending moment. (6 marks)

OR

18. a) Calculate the displacement in the direction of load P applied at a distance of $L/3$ from the left end for a simply supported beam of span L as shown in the figure. (10 marks)



- b) State Castigliano's second theorem and explain its significance. (4 marks)

MODULE – 5

19. a) Find the crippling load for a hollow steel column 50 mm internal diameter and 5 mm thick. The column is 5 m long with one end fixed and other end hinged. Use Rankine's formula and Rankine's constant as $1/7500$ and $\sigma_c = 335 \text{ N/mm}^2$. Compare this load by crippling load given by Euler's formula. Take $E = 110 \text{ GPa}$. (8 marks)

AUTOMOBILE ENGINEERING

b) Explain the maximum normal stress theory, maximum strain energy theory and maximum shear stress theory of failure. (6 marks)

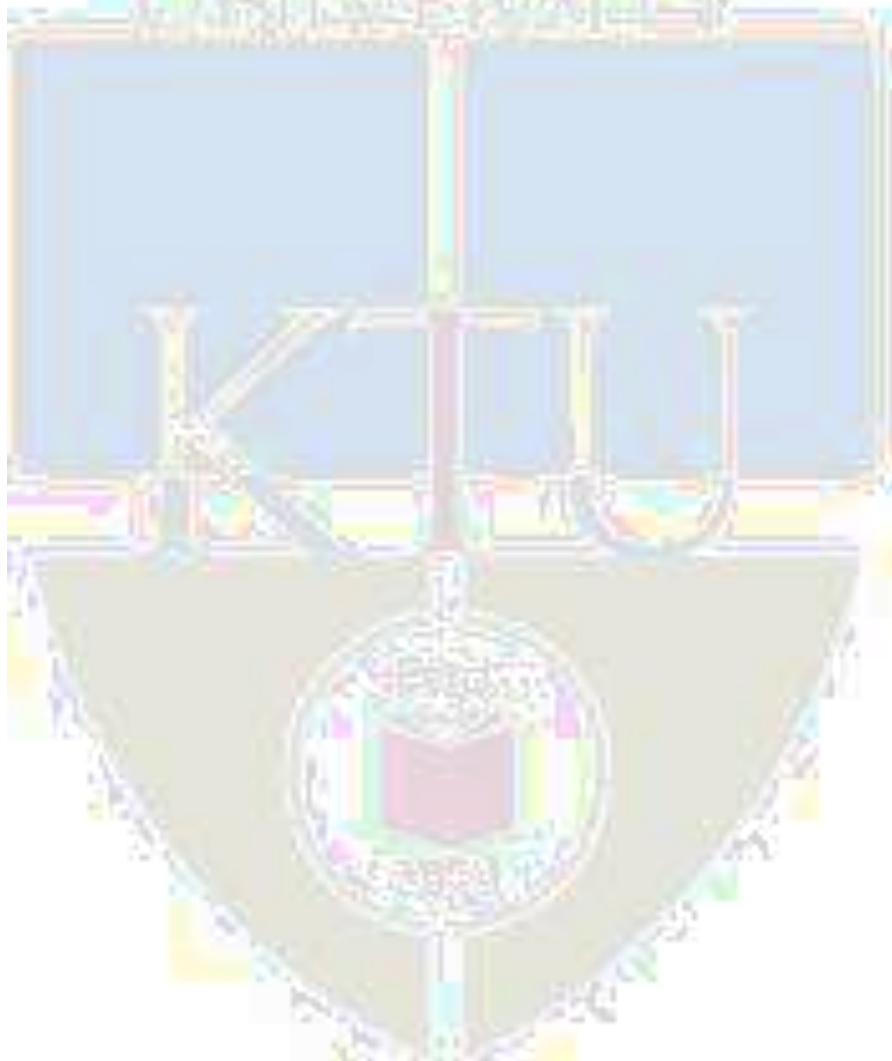
OR

20. a) The principal stresses at a point in an elastic material are 22 N/mm^2 (tensile), 110 N/mm^2 (tensile) and 55 N/mm^2 (compressive). If the elastic limit in simple tension is 210 N/mm^2 , then determine whether the failure of material will occur or not according to Maximum principal stress theory, Maximum shear stress theory and maximum distortion energy theory.

(9 marks)

b) Derive Euler's formula for a column with both ends hinged.

(5 marks)



AUTOMOBILE ENGINEERING

AUT 201	AUTOMOTIVE CHASSIS	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: The aim of this subject is to offer the students a general understanding of various automotive chassis

- ✓ Study of the Constructional details and Theory of important drive line, Structural, Steering, Braking and Suspension Systems of Automobiles.
- ✓ Problem-Solving ability in Steering Mechanism, Propeller Shaft, Braking and Suspension Systems

Prerequisite:

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain different chassis layouts, components and frames, Wheels and Tyres
CO 2	Describe, about various Front Axles, Steering Systems, steering geometry
CO 3	Describe, about Rear Axles, Final drive and differential
CO 4	Describe construction and working of different types of brake systems.
CO 5	Describe construction and working of different types of suspension systems

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
Analyse			
Evaluate			

Create			
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Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 5 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 10 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are the different types of wheels used in an Automobile?
2. What is the different cross –sections used in frames?

Course Outcome 2 (CO2)

1. What are the functions of radius rods in the stability of the vehicle?
2. What is meant by Hotchkiss drive

Course Outcome 3(CO3):

1. Explain the functions of propeller shaft and universal joints?
2. For the same vehicle, if we change the rear axle from fully floating to semi floating, will the axle size increase, decrease or remain the same. Provide the reason behind your answer

Course Outcome 4 (CO4):

1. How bleeding is performed in hydraulic brakes illustrate with supporting figures?
2. Explain the construction and working of drum brakes with simple sketch?

Course Outcome 5 (CO5):

1. Draw and explain the working principle of wishbone type independent suspension system?
2. With the help of neat sketch explain the construction and working of hydra gas suspension

SYLLABUS

Module 1

FRAMES: Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames.

Wheels and Tyres: Types of wheels, construction, structure and function, wheel dimensions, structure and function of tyres, static and dynamic properties of pneumatic tyres, types of tyres, materials, tyre section & designation, factors affecting tyre life, quick change wheels, special wheels, trouble shooting.

Module 2

Front Axle and Steering Systems: Types of Front Axles and Stub Axles, Front Wheel Geometry, viz., Castor, Camber, King Pin Inclination and Toe-in, Condition for True Rolling Motion of Wheels during Steering, Ackerman's and Davis Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over-Steer and Under-Steer, Reversible and Irreversible Steering, Power-Assisted Steering.

Module 3

Propeller Shaft: Construction & types of propeller shafts, Universal Joints and its types, Constant Velocity Universal Joints

Final drive: Construction details, types.

Differential: Principle, types of differential gears, conventional and non-slip differentials, backlash, differential lock, inter-axle differential, transaxle types.

Rear axle: Torque reaction, driving thrust, Hotchkiss drive, torque tube drive, construction of rear axle shaft supporting- fully floating and semi floating arrangements axle housings.

Module 4

Brakes: Necessity, stopping distance and time, brake efficiency, weight transfer, brake shoe theory, determination of braking torque, classification of brakes, types, construction, function, operation, braking systems - mechanical, hydraulic, disc, drum, details of hydraulic system, types of master, wheel cylinder, bleeding of brakes, brake drums, brake linings, brake fluid and its properties, factors influencing operation of brakes such as operating temperature, lining, brake clearance, pedal pressure, linkages etc, Parking and emergency brakes, hill holder, automatic adjustment, servo brakes, Power

AUTOMOBILE ENGINEERING

brakes-Air brakes, vacuum brakes and electric brakes and components brake valve, unloaded valve, diaphragm, air-hydraulic brakes, vacuum boosted hydraulic brakes, trouble shooting.

Module 5

Suspension system: Objects, basic considerations, Types of suspension springs, construction, operation
& Materials, leafsprings, coil springs, torsion bar, rubber springs, plastic springs, air bellows or pneumatic suspension, hydraulic suspension, constructional details of telescopic shock absorbers, independent suspension front wheel independent suspension, rear wheel independent suspension, types, stabilizer, trouble shooting. Numerical Problems

Text Books

1. Kirpal Singh, Automobile Engineering, Standard publications, New Delhi
2. N. K. Giri, Automobile Mechanics, Khanna publishers

Reference Books

- 1) Steering, Suspension and Tyres, Giles. J. G., Iiffe Book Co., London
- 2) The Automotive Chassis, Heldt. P M, Chilton Co.
- 3) Automotive Chassis & Body, P.L. Kohli, TMH

4) Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Module 1 (9 hours)	
1.1	FRAMES: Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames.	5
1.2	Wheels and Tyres: Types of wheels, construction, structure and function, wheel dimensions, structure and function of tyres, static and dynamic properties of pneumatic tyres, types of tyres, materials, tyre section & designation, factors affecting tyre life, quick change wheels, special wheels, trouble shooting.	4
2	Module 2 (9 hours)	
2.1	Front Axle and Steering Systems: Types of Front Axles and Stub Axles, Front Wheel Geometry, viz., Castor, Camber, King Pin Inclination and Toe-in, Condition for True Rolling Motion of Wheels during Steering,	4
2.2	Ackerman's and Davis Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over-Steer and Under-Steer, Reversible and Irreversible Steering, Power-Assisted Steering.	5
3	Module 3 (9 hours)	
3.1	Propeller Shaft: Construction & types of propeller shafts, Universal Joints and its types, Constant Velocity Universal Joints	2

AUTOMOBILE ENGINEERING

3.2	Final drive: Construction details, types.	2
3.3	Differential: Principle, types of differential gears, conventional and non-slip differentials, backlash, differential lock, inter-axle differential, transaxle types.	2
3.4	Rear axle: Torque reaction, driving thrust, Hotchkiss drive, torque tube drive, construction of rear axle shaft supporting- fully floating and semi floating arrangements axle housings.	3
4	Module 4 (9hours)	
4.1	Brakes: Necessity, stopping distance and time, brake efficiency, weight transfer, brake shoe theory	1
4.2	determination of braking torque, classification of brakes, types, construction, function, operation, braking systems - mechanical, hydraulic, disc, drum, details of hydraulic system, types of master, wheel cylinder, bleeding of brakes, brake drums, brake linings, brake fluid and its properties	3
4.3	factors influencing operation of brakes such as operating temperature, lining, brake clearance, pedal pressure, linkages etc, Parking and emergency brakes, hill holder, automatic adjustment, servo brakes, Power brakes-Air brakes, vacuum brakes and electric brakes and components brake valve, unloaded valve, diaphragm, air-hydraulic brakes, vacuum boosted hydraulic brakes, trouble shooting.	5
5	Module V(9 hours)	
5.1	Suspension system: Objects, basic considerations, Types of suspension springs, construction, operation & materials, leafsprings, coil springs, torsion bar, rubber springs, plastic springs, air bellows or pneumatic suspension, hydraulic suspension	5
5.2	constructional details of telescopic shock absorbers	1
5.3	Independent Suspension, Front wheel independent suspension, rear wheel independent suspension, types, stabilizer, trouble shooting. Numerical Problems	3

Model Question paper

QP CODE:

PAGES:3

Reg. No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT 201

Course Name: AUTOMOTIVE CHASSIS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 5 Marks (2 questions from each module)

1. What are the different types of wheels used in an Automobile?
2. What are X- frames.
3. What is the different cross –sections used in frames?
4. Explain the different loads acting on the axles.
5. What are the functions of radius rods in the stability of the vehicle?
6. What is meant by Hotchkiss drive
7. Before differential, how was the automobiles designed
8. List Down the driving forces acting on the driving axle
9. Which are the types of axle housings?
10. What are the functions of a suspension system?

PART B

Answer any one full question from each module.

Each question carries 10 Marks

Module 1

11. Explain various types frames with neat sketches (10)

Or

Model Question paper

QP CODE:

PAGES:3

Reg. No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT 201

Course Name: AUTOMOTIVE CHASSIS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 5 Marks (2 questions from each module)

1. What are the different types of wheels used in an Automobile?
2. What are X- frames.
3. What is the different cross –sections used in frames?
4. Explain the different loads acting on the axles.
5. What are the functions of radius rods in the stability of the vehicle?
6. What is meant by Hotchkiss drive
7. Before differential, how was the automobiles designed
8. List Down the driving forces acting on the driving axle
9. Which are the types of axle housings?
10. What are the functions of a suspension system?

PART B

Answer any one full question from each module.

Each question carries 10 Marks

Module 1

11. Explain various types frames with neat sketches (10)

Or

Model Question paper

QP CODE:

PAGES:3

Reg. No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT 201

Course Name: AUTOMOTIVE CHASSIS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 5 Marks (2 questions from each module)

1. What are the different types of wheels used in an Automobile?
2. What are X- frames.
3. What is the different cross –sections used in frames?
4. Explain the different loads acting on the axles.
5. What are the functions of radius rods in the stability of the vehicle?
6. What is meant by Hotchkiss drive
7. Before differential, how was the automobiles designed
8. List Down the driving forces acting on the driving axle
9. Which are the types of axle housings?
10. What are the functions of a suspension system?

PART B

Answer any one full question from each module.

Each question carries 10 Marks

Module 1

11. Explain various types frames with neat sketches (10)

Or

12. What are the different types of wheels used in an automobile and list down the advantages and disadvantages of each wheel? (10)

Module 2

13. Explain the working of a recirculating ball type steering gearbox with a neat sketch (10)

Or

14. a. Explain Steering error curve (5)
b. explain Oversteer and understeer (5)

Module 3

15. Explain the functions of propeller shaft and universal joints? (10)

Or

16. For the same vehicle, if we change the rear axle from fully floating to semi floating, will the axle size increase, decrease or remain the same. Provide the reason behind your answer (10)

Module 4

17. How bleeding is performed in hydraulic brakes illustrate with supporting figures? (10)

Or

18. Explain the construction and working of drum brakes with simple sketch? (10)

Module 5

AUTOMOBILE ENGINEERING

19. Draw and explain the working principle of wishbone type independent suspension system? (10)

Or

20. With the help of neat sketch explain the construction and working of hydra gas suspension (10)



CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
AUT203	ENGINEERING THERMODYNAMICS	PCC	3	1	-	4

Preamble :

Thermodynamics is the study of energy . Without energy life cannot exist. Activities from breathing to the launching of rockets involves energy transactions and are subject to thermodynamic analysis. Engineering devices like engines, turbines, refrigeration and air conditioning systems, propulsion systems etc., work on energy transformations and must be analysed using principles of thermodynamics. So, a thorough knowledge of thermodynamic concepts is essential for a mechanical engineer. This course offers an introduction to the basic concepts and laws of thermodynamics.

Prerequisite : NIL

Course Outcomes :

After completion of the course the student will be able to

CO1	Understand basic concepts and laws of thermodynamics
CO2	Conduct first law analysis of open and closed systems
CO3	Determine entropy and availability changes associated with different processes
CO4	Understand the application and limitations of different equations of state
CO5	Determine change in properties of pure substances during phase change processes
CO6	Evaluate properties of ideal gas mixtures

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										2
CO2	2	2	1	1								1
CO3	3	3	2	2								1
CO4	2	2	2	2								1
CO5	3	3	2	1								1
CO6	3	3	2	2								1

Assessment Pattern

Blooms Category	CA			ESA
	Assignment	Test - 1	Test - 2	
Remember	25	20	20	10
Understand	25	40	40	20
Apply	25	40	40	70
Analyse	25			
Evaluate				
Create				

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

Mark distribution & Duration of Examination :

Total Marks	CA	ESE	ESE Duration
150	50	100	3 Hours

End semester pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

COURSE LEVEL ASSESSMENT QUESTIONS

Course Outcome 1

1. Discuss the limitations of first law of thermodynamics.
2. Second law of thermodynamics is often called a directional law . Why?
3. Explain Joule-Kelvin effect. What is the significance of the inversion curve ?

Course Outcome 2

1. A mass of 2.4 kg of air at 150 kPa and 12°C is contained in a gas – tight, frictionless piston – cylinder device. The air is now compressed to a final pressure of 600 kPa . During this process, heat is transferred from the air such that the temperature inside the cylinder remains constant. Calculate the work input during this process.
2. Carbon dioxide enters an adiabatic nozzle steadily at 1 MPa and 500°C with a mass flow rate of 600 kg/hr and leaves at 100 kPa and 450 m/s. The inlet area of the nozzle is 40 cm². Determine (a) the inlet velocity and (b) the exit temperature
3. A vertical piston – cylinder device initially contains 0.25 m³ of air at 600 kPa and 300°C. A valve connected to the cylinder is now opened and air is allowed to escape until three-quarters of the mass leave the cylinder at which point the volume is 0.05 m³. Determine the final temperature in the cylinder and the boundary work during this process.

Course Outcome 3

1. An adiabatic vessel contains 2 kg of water at 25°C. By paddle – wheel work transfer, the temperature of water is increased to 30°C. If the specific heat of water is assumed to be constant at 4.186 kJ/kg.K, find the entropy change of the universe.

AUTOMOBILE ENGINEERING

2. Two kilograms of water at 80°C is mixed adiabatically with 3 kg of water at 30°C in a constant pressure process at 1 atm. Find the increase in entropy of the total mass of water due to the mixing process.
3. Argon enters an insulated turbine operating under steady state at 1000°C and 2 MPa and exhausts at 350 kPa. The mass flow rate is 0.5 kg/s and the turbine develops power at the rate of 120 kW. Determine (a) the temperature of the argon at the turbine exit, (b) the irreversibility of the turbine and (c) the second law efficiency. Neglect KE and PE effects. Take $T_o = 20^{\circ}\text{C}$ and $P_o = 1\text{bar}$

Course Outcome 4

1. What are the limitations of ideal gas equation and how does Van der Waals equation overcome these limitations ?
2. Discuss law of corresponding states and its role in the construction of compressibility chart.
3. A rigid tank contains 2 kmol of N_2 and 6 kmol of CH_4 gases at 200 K and 12 MPa. Estimate the volume of the tank, using (a) ideal gas equation of state (b) the compressibility chart and Amagat's law

Course Outcome 5

1. Steam is throttled from 3 MPa and 600°C to 2.5 MPa. Determine the temperature of the steam at the end of the throttling process.
2. Determine the change in specific volume, specific enthalpy and quality of steam as saturated steam at 15 bar expands isentropically to 1 bar. Use steam tables
3. Estimate the enthalpy of vapourization of steam at 500 kPa, using the Clapeyron equation and compare it with the tabulated value

Course Outcome 6

1. A gaseous mixture contains , by volume, 21%nitrogen, 50% hydrogen and 29 % carbon dioxide. Calculate the molecular weight of the mixture, the characteristic gas constant of the mixture and the value of the reversible adiabatic expansion index - γ . At 10°C , the C_p values of nitrogen, hydrogen and carbon dioxide are 1.039, 14.235 and 0.828 kJ/kg.K respectively.
2. A mixture of 2 kmol of CO_2 and 3 kmol of air is contained in a tank at 199 kPa and 20°C . Treating air to be a mixture of 79% N_2 and 21% O_2 by volume , calculate (a) the individual mass of CO_2 , N_2 and O_2 , (b) the percentage content of carbon by mass in the mixture and (c) the molar mass , characteristic gas constant and the specific volume of the mixture
3. A gas mixture in an engine cylinder has 12% CO_2 , 11.5 % O_2 and 76.5% N_2 by volume. The mixture at 1000°C expands reversibly, according to the law $PV^{1.25} = \text{constant}$, to 7 times its initial volume. Determine the work transfer and heat transfer per unit mass of the mixture.

SYLLABUS

Module 1: Role of Thermodynamics and its applications in Engineering and Science –Basic Concepts Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic System and Control Volume, Surrounding, Boundaries, Types of Systems, Universe, Thermodynamic properties, Process, Cycle, Thermodynamic Equilibrium, Quasi – static Process, State, Point and Path function. Zeroth Law of Thermodynamics, Measurement of Temperature, reference Points, Temperature Scales.

Module 2: Energy - Work - Pdv work and other types of work transfer, free expansion work, heat and heat capacity. Joule's Experiment- First law of Thermodynamics - First law applied to Non flow Process- Enthalpy- specific heats- PMM1, First law applied to Flow Process, Mass and Energy balance in simple steady flow process. Applications of SFEE, Transient flow –Filling and Emptying Process, Limitations of the First Law.

Module 3: Second Law of Thermodynamics, Thermal Reservoir, Heat Engine, Heat pump – Kelvin-Planck and Clausius Statements, Equivalence of two statements, Reversibility, Irreversible Process, Causes of Irreversibility, PMM2, Carnot's theorem and its corollaries, Absolute Thermodynamic Temperature scale. Clausius Inequality, Entropy- Entropy changes in various thermodynamic processes, principle of increase of entropy and its applications, Entropy generation, Entropy and Disorder, Reversible adiabatic process- isentropic process, Third law of thermodynamics, Available Energy, Availability and Irreversibility- Second law efficiency.

Module 4: Pure Substances, Phase Transformations, Triple point, properties during change of phase, T-v, p-v and p-T diagram of pure substance, p-v-T surface, Saturation pressure and Temperature, T-h and T-s diagrams, h-s diagrams or Mollier Charts, Dryness Fraction, steam tables. Property calculations using steam tables. The ideal Gas Equation, Characteristic and Universal Gas constants, Deviations from ideal Gas Model: Equation of state of real substances, Vander Waals Equation of State, Virial Expansion, Compressibility factor, Law of corresponding state, Compressibility charts.

Module 5: Mixtures of ideal Gases – Mole Fraction, Mass fraction, Gravimetric and volumetric Analysis, Dalton's Law of partial pressure, Amagat's Laws of additive volumes, Gibbs-Dalton's law Equivalent Gas constant and Molecular Weight, Properties of gas mixtures: Internal Energy, Enthalpy, specific heats and Entropy, Introduction to real gas mixtures- Kay's rule. General Thermodynamic Relations – Combined First and Second law equations – Helmholtz and Gibb's functions - Maxwell's Relations, Tds Equations. The Clapeyron Equation, equations for internal energy, enthalpy and entropy, specific heats, Throttling process, Joule Thomson Coefficient, inversion curve.

Text Books

1. P. K. Nag, Engineering Thermodynamics, McGraw Hill, 2013
2. E. Rathakrishnan Fundamentals of Engineering Thermodynamics, PHI, 2005
3. Y. A. Cengel and M. A. Boles, Thermodynamics an Engineering Approach, McGraw Hill, 2011

Reference Books:

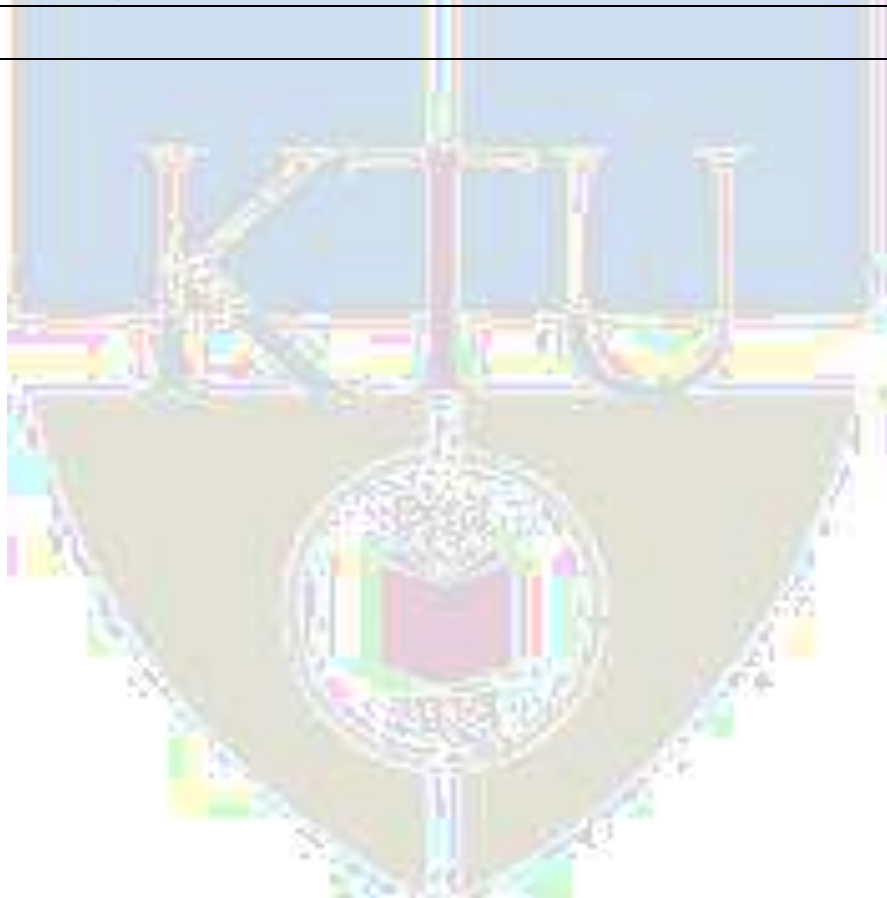
1. Moran J., Shapiro N. M., Fundamentals of Engineering Thermodynamics, Wiley, 2006
2. R. E. Sonntag and C. Borgnakke, Fundamentals of Thermodynamics, Wiley, 2009
3. Holman J. P. Thermodynamics, McGraw Hill, 2004
4. M. Achuthan, Engineering Thermodynamics, PHI, 2004

COURSE PLAN

Module	Topics	Hours Allotted
1	Role of Thermodynamics and it's applications in Engineering and Science – Basic Concepts Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic System and Control Volume, Surrounding, Boundaries, Types of Systems, Universe	1L
	Thermodynamic properties, Process, Cycle, Thermodynamic Equilibrium, Quasi – static Process, State, Point and Path function.	1L
	Zeroth Law of Thermodynamics, Measurement of Temperature, reference Points, Temperature Scales.	2L + 1T
2	Energy - Work - Pdv work and other types of work transfer, free expansion work, heat and heat capacity.	2L + 1T
	Joule's Experiment- First law of Thermodynamics - First law applied to Non flow Process- Enthalpy- specific heats- PMM1	2L + 1T
	First law applied to Flow Process, Mass and Energy balance in simple steady flow process. Applications of SFEE	2L + 1T
	Transient flow –Filling and Emptying Process, Limitations of the First Law.	1L + 1T
3	Second Law of Thermodynamics, Thermal Reservoir, Heat Engine, Heat pump – Kelvin-Planck and Clausius Statements, Equivalence of two statements	2L
	Reversibility, Irreversible Process, Causes of Irreversibility, PMM2, Carnot's theorem and its corollaries, Absolute Thermodynamic Temperature scale.	2L + 1T
	Clausius Inequality, Entropy- Entropy changes in various thermodynamic processes, principle of increase of entropy and its applications, Entropy generation, Entropy and Disorder, Reversible adiabatic process- isentropic process, Third law of thermodynamics	2L + 1T
	Available Energy, Availability and Irreversibility- Second law efficiency.	2L + 1T
	Pure Substances, Phase Transformations, Triple point, properties during change of phase, T-v, p-v and p-T diagram of pure substance, p-v-T surface,	2L

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4	Saturation pressure and Temperature, T-h and T-s diagrams, h-s diagrams or Mollier Charts, Dryness Fraction, steam tables. Property calculations using steam tables	2L + 1T
	The ideal Gas Equation, Characteristic and Universal Gas constants, Deviations from ideal Gas Model: Equation of state of real substances, Vander Waals Equation of State, Virial Expansion, Compressibility factor, Law of corresponding state, Compressibility charts.	2L +1T
5	Mixtures of ideal Gases – Mole Fraction, Mass fraction, Gravimetric and volumetric Analysis, Dalton's Law of partial pressure, Amagat's Laws of additive volumes, Gibbs-Dalton's law.	2L
	Equivalent Gas constant and Molecular Weight, Properties of gas mixtures: Internal Energy, Enthalpy, specific heats and Entropy	1L +1T
	Introduction to real gas mixtures- Kay's rule	1L
	General Thermodynamic Relations – Combined First and Second law equations – Helmholtz and Gibb's functions - Maxwell's Relations	2L
	Tds Equations. The Clapeyron Equation, equations for internal energy, enthalpy and entropy, specific heats, Throttling process, Joule Thomson Coefficient, inversion curve.	2L + 1T



MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION

Course Code : AUT203

Course Name : ENGINEERING THERMODYNAMICS

(Permitted to use Steam Tables and Mollier Chart)

Max. Marks : 100

Duration : 3 Hours

Part – A

Answer all questions.

1. Define thermodynamics. List a few of its applications
2. Differentiate between intensive and extensive properties.
3. Differentiate between heat and work.
4. Explain system approach and control volume approach as applied in the analysis of a flow process.
5. An inventor claims to have developed an engine that delivers 26 kJ of work using 82 kJ of heat while operating between temperatures 120°C and 30°C. Is his claim valid ? Give the reason for your answer.
6. Show that two reversible adiabatics cannot intersect
7. Define (i) critical point and (ii) triple point, with respect to water
8. Why do real gases deviate from ideal gas behaviour? When do they approach ideal behaviour?
9. Define Helmholtz function and Gibbs function and state their significance
10. Explain Kay's rule of real gas mixtures

(3 x 10 = 30 marks)

Part – B

Answer one full question from each module.

Module - 1

- 11.a] Explain macroscopic and microscopic approach to thermodynamics .

(7 marks)

AUTOMOBILE ENGINEERING

b] With the aid of a suitable diagram, explain the working of constant volume gas thermometer.

(7 marks)

OR

12.a] What is meant by thermodynamic equilibrium ? What are the essential conditions for a system to be in thermodynamic equilibrium ? (7 marks)

b] Express the temperature of 91°C in (i) Fahrenheit (ii) Kelvin (iii) Rankine. (7 marks)

Module – 2

13.a] A mass of 2.4 kg of air at 150 kPa and 12°C is contained in a gas – tight, frictionless piston – cylinder device. The air is now compressed to a final pressure of 600 kPa . During this process, heat is transferred from the air such that the temperature inside the cylinder remains constant. Calculate the work input during this process. (7 marks)

b] A 2 m^3 rigid tank initially contains air at 100 kPa and 22°C . The tank is connected to a supply line through a valve. Air is flowing in the supply line at 600 kPa and 22°C . The valve is opened, and air is allowed to enter the tank until the pressure in the tank reaches the line pressure, at which point the valve is closed. A thermometer placed in the tank indicates that the air temperature at the final state is 77°C . Determine, (i) the mass of air that has entered the tank and (ii) the amount of heat transfer. (7 marks)

OR

14.a] A turbine operates under steady flow conditions, receiving steam at the following conditions : pressure 1.2 MPa, temperature 188°C , enthalpy 2785 kJ/kg, velocity 33.3 m/s and elevation 3m. The steam leaves the turbine at the following conditions : pressure 20 kPa, enthalpy 25kJ/kg, velocity 100 m/s, and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29 kJ/s. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of the turbine in kW ? (7 marks)

b] State the general energy balance equation for an unsteady flow system and from it, derive the energy balance equation for a bottle filling process, stating all assumptions. (7 marks)

Module – 3

15.a] State the Kelvin-Planck and Clausius statements of the second law of thermodynamics and prove their equivalence. (7 marks)

b] A heat engine operating between two reservoirs at 1000 K and 300 K is used to drive a heat pump which extracts heat from the reservoir at 300 K at a rate twice that at which the engine rejects heat to it. If the efficiency of the engine is 40 % of the maximum possible and the COP of the heat pump is 50 % of the maximum possible, what is the temperature of the reservoir to which the heat pump rejects heat ? What is the rate of heat rejection from the heat pump, if the rate of heat supply to the engine is 50kW ? (7 marks)

OR

AUTOMOBILE ENGINEERING

16.a] A house is to be maintained at 21°C during winter and at 26°C during summer. Heat leakage through the walls, windows and roof is about 3000 kJ/hr per degree temperature difference between the interior of the house and the environment. A reversible heat pump is proposed for realising the desired heating and cooling. What is the minimum power required to run the heat pump in the reverse, if the outside temperature during summer is 36°C ? Also find the lowest environment temperature during winter for which the inside of the house can be maintained at 21°C consuming the same power. (7 marks)

b] Air enters a compressor in steady flow at 140 kPa , 17°C and 70 m/s and leaves at 350 kPa , 127°C and 110 m/s . The environment is at 100 kPa and 7°C . Calculate per kg of air (a) the actual work required (b) the minimum work required and (c) the irreversibility of the process. (7 marks)

Module – 4

17.a] Show the constant pressure transformation of unit mass of ice at atmospheric pressure and -20°C to superheated steam at 220°C on P-v , T-v and P-T coordinate systems and explain their salient features . (7 marks)

b] A rigid vessel of volume 0.3 m^3 contains 10 kg of oxygen at 300 K . Using (i) the perfect gas equation and (ii) the Van der Waal's equation of state, determine the pressure of oxygen in the vessel. Take the Van der Waal's constants for oxygen as $a = 0.1382 \text{ m}^6 \text{ Pa/mol}^2$ and $b = 0.03186 \text{ m}^3/\text{kmol}$. (7 marks)

OR

18.a] Steam at 25 bar and 300°C expands isentropically to 5 bar . Calculate the change in enthalpy, volume and temperature of unit mass of steam during this process using steam tables and Mollier chart and compare the values (7 marks)

b] Explain law of corresponding states and its significance to the generalized compressibility chart. (7 marks)

Module – 5

19.a] Derive the expressions for the equivalent molecular weight and characteristic gas constant for a mixture of ideal gases. (6 marks)

b] 0.5 kg of Helium and 0.5 kg of Nitrogen are mixed at 20°C and at a total pressure of 100 kPa . Find (i) volume of the mixture (ii) partial volumes of the components (iii) partial pressures of the

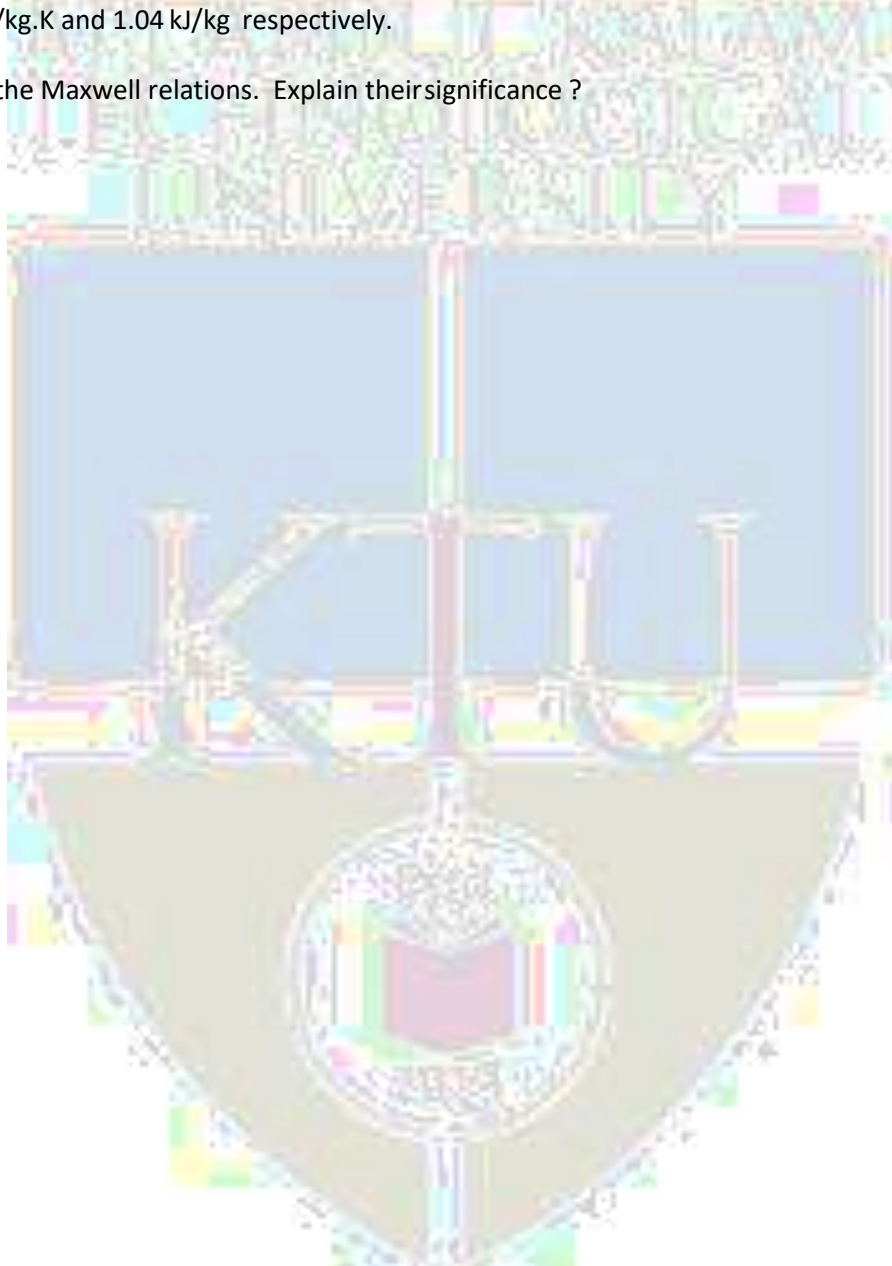
AUTOMOBILE ENGINEERING

components (iv) the specific heats of the mixture and (v) the gas constant of the mixture. Take ratio of specific heats for Helium and Nitrogen to be 1.667 and 1.4 respectively. (8 marks)

OR

20.a] 2 kg of carbon dioxide at 38°C and 1.4 bar is mixed with 5 kg of nitrogen at 150°C and 1.03 bar to form a mixture at a final pressure of 70 kPa. The process occurs adiabatically in a steady flow apparatus. Calculate the final temperature of the mixture and the change in entropy during the mixing process. Take specific heat at constant pressure for CO₂ and N₂ as 0.85 kJ/kg.K and 1.04 kJ/kg respectively. (7 marks)

b] Derive the Maxwell relations. Explain their significance ? (7 marks)



CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
EST 200	DESIGN AND ENGINEERING		2	0	0	2

Preamble:

The purpose of this course is to

- i) introduce the undergraduate engineering students the fundamental principles of design engineering,
- ii) make them understand the steps involved in the design process and
- iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

Prerequisite:

Nil. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Explain the different concepts and principles involved in design engineering.
CO 2	Apply design thinking while learning and practicing engineering.
CO 3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1					1			1		
CO 2		2				1		1				2
CO 3			2			1	1		2	2		1

Assessment Pattern**Continuous Internal Evaluation (CIE) Pattern:**

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B.

Part A : 30 marks

part B : 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1): Appreciate the different concepts and principles involved in design engineering.

1. State how engineering design is different from other kinds of design
2. List the different stages in a design process.
3. Describe design thinking.
4. State the function of prototyping and proofing in engineering design.
5. Write notes on the following concepts in connection with design engineering 1) Modular Design, 2) Life Cycle Design, 3) Value Engineering, 4) Concurrent Engineering, and 5) Reverse Engineering
6. State design rights.

Course Outcome 2 (CO2) Apply design thinking while learning and practicing engineering.

1. Construct the iterative process for design thinking in developing simple products like a pen, umbrella, bag, etc.
2. Show with an example how divergent-convergent thinking helps in generating alternative designs and then how to narrow down to the best design.
3. Describe how a problem-based learning helps in creating better design engineering solutions.
4. Discuss as an engineer, how ethics play a decisive role in your designs

Course Outcome 3 (CO3): Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering.

1. Illustrate the development of any simple product by passing through the different stages of design process
2. Show the graphical design communication with the help of detailed 2D or 3D drawings for any simple product.
3. Describe how to develop new designs for simple products through bio-mimicry.

Model Question paper

Page 1 of 2

Reg No.: _____ Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION**Course Code: EST 200****Course Name: DESIGN AND ENGINEERING****Max. Marks: 100 Duration: 3 Hours****PART A****Answer all questions, each question carries 3 marks****Use only hand sketches**

- (1) Write about the basic design process.
- (2) Describe how to finalize the design objectives.
- (3) State the role of divergent-convergent questioning in design thinking.
- (4) Discuss how to perform design thinking in a team managing the conflicts.
- (5) Show how engineering sketches and drawings convey designs.
- (6) Explain the role of mathematics and physics in design engineering process.
- (7) Distinguish between project-based learning and problem-based learning in design engineering.
- (8) Describe how concepts like value engineering, concurrent engineering and reverse engineering influence engineering designs?
- (9) Show how designs are varied based on the aspects of production methods, life span, reliability and environment?
- (10) Explain how economics influence the engineering designs?

(10x3 marks =30 marks)**Part B****Answer any ONE question from each module. Each question carry 14 marks****Module 1**

- (11) Show the designing of a wrist watch going through the various stages of the design process. Use hand sketches to illustrate the processes.
- or**
- (12) Find the customer requirements for designing a new car showroom. Show how the design objectives were finalized considering the design constraints?

Module 2

- (13) Illustrate the design thinking approach for designing a bag for college students within a limited budget. Describe each stage of the process and the iterative procedure involved. Use hand sketches to support your arguments.

or

- (14) Construct a number of possible designs and then refine them to narrow down to the best design for a drug trolley used in hospitals. Show how the divergent-convergent thinking helps in the process. Provide your rationale for each step by using hand sketches only.

Module 3

- (15) Graphically communicate the design of a thermo flask used to keep hot coffee. Draw the detailed 2D drawings of the same with design detailing, material selection, scale drawings, dimensions, tolerances, etc. Use only hand sketches.

or

- (16) Describe the role of mathematical modelling in design engineering. Show how mathematics and physics play a role in designing a lifting mechanism to raise 100 kg of weight to a floor at a height of 10 meters in a construction site.

Module 4

- (17) Show the development of a nature inspired design for a solar powered bus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

or

- (18) Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

Module 5

- (19) Examine the changes in the design of a foot wear with constraints of 1) production methods, 2) life span requirement, 3) reliability issues and 4) environmental factors. Use hand sketches and give proper rationalization for the changes in design.

or

- (20) Describe the how to estimate the cost of a particular design using ANY of the following:
i) a website, ii) the layout of a plant, iii) the elevation of a building, iv) an electrical or electronic system or device and v) a car.

Show how economics will influence the engineering designs. Use hand sketches to support your arguments.

(5x14 marks =70 marks)

Syllabus**Module 1**

Design Process:- Introduction to Design and Engineering Design, Defining a Design Process:-Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Module 2

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

Module 3

Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

Module 4

Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

Module 5

Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

Text Books

- 1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,
- 2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

Reference Books

1. Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.
2. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361
4. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	<u>Module 1: Design Process</u>	
1.1	Introduction to Design and Engineering Design. <i>What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabulary in engineering design? How to learn and do engineering design.</i>	1
1.2	Defining a Design Process:- Detailing Customer Requirements. <i>How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?</i>	1
1.3	Defining a Design Process:- Setting Design Objectives, Identifying Constraints, Establishing Functions. <i>How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?</i>	1
1.4	Defining a Design Process:- Generating Design Alternatives and Choosing a Design. <i>How to generate or create feasible design alternatives? How to identify the "best possible design"?</i>	1
1.5	Case Studies:- Stages of Design Process. <i>Conduct exercises for designing simple products going through the different stages of design process.</i>	1
2	<u>Module 2: Design Thinking Approach</u>	
2.1	Introduction to Design Thinking <i>How does the design thinking approach help engineers in creating innovative and efficient designs?</i>	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. <i>How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?</i>	1
2.3	Design Thinking as Divergent-Convergent Questioning. <i>Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.</i>	1
2.4	Design Thinking in a Team Environment. <i>How to perform design thinking as a team managing the conflicts ?</i>	1
2.5	Case Studies: Design Thinking Approach. <i>Conduct exercises using the design thinking approach for</i>	1

	<i>designing any simple products within a limited time and budget</i>	
3	<u>Module 3: Design Communication (Languages of Engineering Design)</u>	
3.1	Communicating Designs Graphically. <i>How do engineering sketches and drawings convey designs?</i>	1
3.2	Communicating Designs Orally and in Writing. <i>How can a design be communicated through oral presentation or technical reports efficiently?</i>	1
First Series Examination		
3.3	Mathematical Modelling in Design. <i>How do mathematics and physics become a part of the design process?</i>	1
3.4	Prototyping and Proofing the Design. <i>How to predict whether the design will function well or not?</i>	1
3.5	Case Studies: Communicating Designs Graphically. <i>Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.</i>	1
4	<u>Module 4: Design Engineering Concepts</u>	
4.1	Project-based Learning and Problem-based Learning in Design. <i>How engineering students can learn design engineering through projects?</i> <i>How students can take up problems to learn design engineering?</i>	1
4.2	Modular Design and Life Cycle Design Approaches. <i>What is modular approach in design engineering? How it helps?</i> <i>How the life cycle design approach influences design decisions?</i>	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. <i>How do aesthetics and ergonomics change engineering designs?</i> <i>How do the intelligence in nature inspire engineering designs? What are the common examples of bio-mimicry in engineering?</i>	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. <i>How do concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?</i>	1
4.5	Case Studies: Bio-mimicry based Designs. <i>Conduct exercises to develop new designs for simple</i>	1

	<i>products using bio-mimicry and train students to bring out new nature inspired designs.</i>	
5	<u>Module 5: Expediency, Economics and Environment in Design Engineering</u>	
5.1	Design for Production, Use, and Sustainability. <i>How designs are finalized based on the aspects of production methods, life span, reliability and environment?</i>	1
5.2	Engineering Economics in Design. <i>How to estimate the cost of a particular design and how will economics influence the engineering designs?</i>	1
5.3	Design Rights. <i>What are design rights and how can an engineer put it into practice?</i>	1
5.4	Ethics in Design. <i>How do ethics play a decisive role in engineering design?</i>	1
5.5	Case Studies: Design for Production, Use, and Sustainability. <i>Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental factors.</i>	1
Second Series Examination		

Code.	Course Name	L	T	P	Hrs	Credit
HUT 200	Professional Ethics	2	0	0	2	2

Preamble: To enable students to create awareness on ethics and human values.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the core values that shape the ethical behaviour of a professional.
CO 2	Adopt a good character and follow an ethical life.
CO 3	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO 4	Solve moral and ethical problems through exploration and assessment by established experiments.
CO 5	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1								2			2	
CO 2								2			2	
CO 3								3			2	
CO 4								3			2	
CO 5								3			2	

Assessment Pattern

Bloom's category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understood	20	20	40
Apply	15	15	30

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Tests (2 Nos)	: 25 marks
Assignments/Quiz	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Define integrity and point out ethical values.
2. Describe the qualities required to live a peaceful life.
3. Explain the role of engineers in modern society.

Course Outcome 2 (CO2)

1. Derive the codes of ethics.
2. Differentiate consensus and controversy.
3. Discuss in detail about character and confidence.

Course Outcome 3(CO3):

1. Explain the role of professional's ethics in technological development.
2. Distinguish between self interest and conflicts of interest.
3. Review on industrial standards and legal ethics.

Course Outcome 4 (CO4):

1. Illustrate the role of engineers as experimenters.
2. Interpret the terms safety and risk.
3. Show how the occupational crimes are resolved by keeping the rights of employees.

Course Outcome 5 (CO5):

1. Exemplify the engineers as managers.
2. Investigate the causes and effects of acid rain with a case study.
3. Explore the need of environmental ethics in technological development.

Model Question paper

QP CODE:

Reg No: _____

PAGES:3

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD/FOURTH SEMESTER
B.TECH DEGREE EXAMINATION, MONTH & YEAR****Course Code: HUT 200****Course Name: PROFESSIONAL ETHICS****Max. Marks: 100****Duration: 3 Hours****(2019-Scheme)****PART A****(Answer all questions, each question carries 3 marks)**

1. Define empathy and honesty.
2. Briefly explain about morals, values and ethics.
3. Interpret the two forms of self-respect.
4. List out the models of professional roles.
5. Indicate the advantages of using standards.
6. Point out the conditions required to define a valid consent?
7. Identify the conflicts of interests with an example?
8. Recall confidentiality.
9. Conclude the features of biometric ethics.
10. Name any three professional societies and their role relevant to engineers.

(10x3 = 30 marks)**PART B****(Answer one full question from each module, each question carries 14 marks)****MODULE I**

11. a) Classify the relationship between ethical values and law?

b) Compare between caring and sharing.

(10+4 = 14 marks)

Or

12. a) Exemplify a comprehensive review about integrity and respect for others.

b) Discuss about co-operation and commitment.

(8+6 = 14 marks)

MODULE II

13.a) Explain the three main levels of moral developments, devised by Kohlberg.

b) Differentiate moral codes and optimal codes.

(10+4 = 14 marks)

Or

14. a) Extrapolate the duty ethics and right ethics.

b) Discuss in detail the three types of inquiries in engineering ethics

(8+6 = 14 marks)

MODULE III

15.a) Summarize the following features of morally responsible engineers.

(i) Moral autonomy

(ii) Accountability

b) Explain the rights of employees

(8+6 = 14 marks)

Or

16. a) Explain the reasons for Chernobyl mishap ?

b) Describe the methods to improve collegiality and loyalty.

(8+6 = 14 marks)

MODULE IV

17.a) Execute collegiality with respect to commitment, respect and connectedness.

b) Identify conflicts of interests with an example.

(8+6 = 14 marks)

Or

18. a) Explain in detail about professional rights and employee rights.

b) Exemplify engineers as managers.

MODULE V

19.a) Evaluate the technology transfer and appropriate technology.

b) Explain about computer and internet ethics.

(8+6 = 14 marks)

Or

20. a) Investigate the causes and effects of acid rain with a case study.

b) Conclude the features of ecocentric and biocentric ethics.

(8+6 = 14 marks)

Syllabus

Module 1 – Human Values.

Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue- Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment- Empathy-Self Confidence -Social Expectations.

Module 2 - Engineering Ethics & Professionalism.

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action –Self interest-Customs and Religion- Uses of Ethical Theories.

Module 3- Engineering as social Experimentation.

Engineering as Experimentation – Engineers as responsible Experimenters- Codes of Ethics- Plagiarism- A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

Module 4- Responsibilities and Rights.

Collegiality and loyalty – Managing conflict- Respect for authority- Collective bargaining- Confidentiality- Role of confidentiality in moral integrity-Conflicts of interest- Occupational crime- Professional rights- Employee right- IPR Discrimination.

Module 5- Global Ethical Issues.

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics -Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and advisors-Moral leadership.

Text Book

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited ,New Delhi,2006.

Reference Books

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states,2005.
4. <http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics>.

Course Contents and Lecture Schedule

SL.No	Topic	No. of Lectures 25
1	Module 1 – Human Values.	
1.1	Morals, values and Ethics, Integrity, Academic Integrity, Work Ethics	1
1.2	Service Learning, Civic Virtue, Respect for others, Living peacefully	1
1.3	Caring and Sharing, Honesty, Courage, Co-operation commitment	2
1.4	Empathy, Self Confidence, Social Expectations	1
2	Module 2- Engineering Ethics & Professionalism.	
2.1	Senses of Engineering Ethics, Variety of moral issues, Types of inquiry	1
2.2	Moral dilemmas, Moral Autonomy, Kohlberg's theory	1
2.3	Gilligan's theory, Consensus and Controversy, Profession & Professionalism, Models of professional roles, Theories about right action	2
2.4	Self interest-Customs and Religion, Uses of Ethical Theories	1
3	Module 3- Engineering as social Experimentation.	
3.1	Engineering as Experimentation, Engineers as responsible Experimenters	1
3.2	Codes of Ethics, Plagiarism, A balanced outlook on law	2
3.3	Challenger case study, Bhopal gas tragedy	2
4	Module 4- Responsibilities and Rights.	
4.1	Collegiality and loyalty, Managing conflict, Respect for authority	1
4.2	Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest	2
4.3	Occupational crime, Professional rights, Employee right, IPR Discrimination	2
5	Module 5- Global Ethical Issues.	
5.1	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics	2
5.2	Role in Technological Development, Moral leadership	1
5.3	Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	2

CODE	SUSTAINABLE ENGINEERING	CATEGORY	L	T	P	CREDIT
MCN201			2	0	0	NIL

Preamble: Objective of this course is to inculcate in students an awareness of environmental issues and the global initiatives towards attaining sustainability. The student should realize the potential of technology in bringing in sustainable practices.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the relevance and the concept of sustainability and the global initiatives in this direction
CO 2	Explain the different types of environmental pollution problems and their sustainable solutions
CO 3	Discuss the environmental regulations and standards
CO 4	Outline the concepts related to conventional and non-conventional energy
CO 5	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	3					2
CO 2						2	3					2
CO 3						2	3					2
CO 4						2	3					2
CO 5						2	3					2

Assessment Pattern

Mark distribution

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
 Continuous Assessment Test (2 numbers) : 25 marks
 Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the relevance and the concept of sustainability and the global initiatives in this direction

1. Explain with an example a technology that has contributed positively to sustainable development.
2. Write a note on Millennium Development Goals.

Course Outcome 2 (CO2): Explain the different types of environmental pollution problems and their sustainable solutions

1. Explain the 3R concept in solid waste management?
2. Write a note on any one environmental pollution problem and suggest a sustainable solution.
3. In the absence of green house effect the surface temperature of earth would not have been suitable for survival of life on earth. Comment on this statement.

Course Outcome 3(CO3): Discuss the environmental regulations and standards

1. Illustrate Life Cycle Analysis with an example of your choice.
2. “Nature is the most successful designer and the most brilliant engineer that has ever evolved”. Discuss.

Course Outcome 4 (CO4): Outline the concepts related to conventional and non-conventional energy

1. Suggest a sustainable system to generate hot water in a residential building in tropical climate.
2. Enumerate the impacts of biomass energy on the environment.

Course Outcome 5 (CO5): Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

1. Suggest suitable measures to make the conveyance facilities used by your institution sustainable.

Model Question paper

Part A

(Answer all questions. Each question carries 3 marks each)

1. Define sustainable development.
2. Write a short note on Millennium Development Goals.
3. Describe carbon credit.
4. Give an account of climate change and its effect on environment.
5. Describe biomimicry? Give two examples.
6. Explain the basic concept of Life Cycle Assessment.
7. Name three renewable energy sources.

8. Mention some of the disadvantages of wind energy.
9. Enlist some of the features of sustainable habitat.
10. Explain green engineering.

Part B

(Answer one question from each module. Each question carries 14 marks)

11. Discuss the evolution of the concept of sustainability. Comment on its relevance in the modern world.
OR
12. Explain Clean Development Mechanism.
OR
13. Explain the common sources of water pollution and its harmful effects.
OR
14. Give an account of solid waste management in cities.
OR
15. Explain the different steps involved in the conduct of Environmental Impact Assessment.
OR
16. Suggest some methods to create public awareness on environmental issues.
OR
17. Comment on the statement, “Almost all energy that man uses comes from the Sun”.
OR
18. Write notes on:
 - a. Land degradation due to water logging.
 - b. Over exploitation of water.
19. Discuss the elements related to sustainable urbanisation.
OR
20. Discuss any three methods by which you can increase energy efficiency in buildings.

Syllabus

Sustainability- need and concept, technology and sustainable development-Natural resources and their pollution, Carbon credits, Zero waste concept. Life Cycle Analysis, Environmental Impact Assessment studies, Sustainable habitat, Green buildings, green materials, Energy, Conventional and renewable sources, Sustainable urbanization, Industrial Ecology.

Module 1

Sustainability: Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

Module 2

Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.

Module 3

Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

Module 4

Resources and its utilisation: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.

Module 5

Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.

Reference Books

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, PrenticeHall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
5. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
6. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
7. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
8. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Sustainability	
1.1	Introduction, concept, evolution of the concept	1
1.2	Social, environmental and economic sustainability concepts	1
1.3	Sustainable development, Nexus between Technology and Sustainable development	1
1.4	Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs)	1
1.5	Clean Development Mechanism (CDM)	1
2	Environmental Pollution	
2.1	Air Pollution and its effects	1
2.2	Water pollution and its sources	1
2.3	Zero waste concept and 3 R concepts in solid waste management	1
2.4	Greenhouse effect, Global warming, Climate change, Ozone layer depletion	1
2.5	Carbon credits, carbon trading and carbon foot print.	1
2.6	Legal provisions for environmental protection.	1
3	Environmental management standards	
3.1	Environmental management standards	1
3.2	ISO 14001:2015 frame work and benefits	1
3.3	Scope and Goal of Life Cycle Analysis (LCA)	1
3.4	Circular economy, Bio-mimicking	1
3.5	Environment Impact Assessment (EIA)	1
3.6	Industrial Ecology, Industrial Symbiosis	1
4	Resources and its utilisation	
4.1	Basic concepts of Conventional and non-conventional energy	1
4.2	General idea about solar energy, Fuel cells	1
4.3	Wind energy, Small hydro plants, bio-fuels	1
4.4	Energy derived from oceans and Geothermal energy	1
5	Sustainability Practices	
5.1	Basic concept of sustainable habitat	1
5.2	Methods for increasing energy efficiency of buildings	1
5.3	Green Engineering	1
5.4	Sustainable Urbanisation, Sustainable cities, Sustainable transport	1

AUTOMOBILE ENGINEERING

CODE AUL201	COURSE NAME AUTOMOBILE LAB I	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble:

This lab is mainly focussed to develop a platform where the students can enhance their engineering knowledge in the dismantling and assembling of various automobile components by applying their theoretical knowledge acquired.

Prerequisite: Nil

Course Outcomes:

After the completion of the course the student will be able to

CO 1	To study about hand tools, special purpose tools, and their uses.
CO 2	To familiarize with various systems and components of an automobile.
CO 3	To know about writing technical specifications and description of all types of chassis
CO 4	To know about writing technical specifications and description of transmission components of automobiles
CO 5	To know about writing technical specifications and description of body and interiors

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1						2	3	2		2
CO 2	2	1						2	3	2		2
CO 3	2	1						2	3	2		2
CO 4	2	1						2	3	2		2
CO 5	2	1						2	3	2		2

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work	:	15 Marks
(b) Implementing the work/Conducting the experiment	:	10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting)	:	25 Marks
(d) Viva voce	:	20 marks
(e) Record	:	5 Marks

General instructions:

Practical examination to be conducted after the second series test covering minimum 12 exercises/experiments given below. End Semester Examination Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

SYLLABUS

LIST OF EXPERIMENTS

Study

1. Study of hand tools, special purpose tools, sketching and it's uses

List of Exercises/Experiments

1. Servicing of A. C. mechanical fuel pump and Electric Fuel pump
2. Servicing of Carburetor / Fuel injection pump with injector
3. Disassembling cylinder head, decarbonizing
4. Valve timing setting including valve clearance adjustment.
5. Compression test of petrol and diesel engine.
6. Disassembling of engine: inspection of engine components, servicing of components, measurement of dimensions of different components of engine, compare with standard specifications, piston ring setting, assembling using special tools.
7. Servicing of clutch assembly

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8. Dismantling of gear box, inspecting components, servicing, checking the gear ratios.
9. Dismantling of differential assembly, servicing, backlash adjustments, check for drive axis ratio.
10. Dismantle and assemble C.V joint. Also examine a slip joint, U.J cross in propeller shaft.
11. Servicing master and wheel cylinders in hydraulic brake system & bleeding of brakes.
12. Study of steering system. Servicing of steering gear box, checking for end play in shafts.
13. Overhauling of Macpherson Strut suspension system.
14. Dismantling and assembling of front Axle
15. Brake and Clutch adjustment of two wheeler as per specification.
16. Performance test on shock absorber / coil spring of two wheeler.
17. Performance test of a two wheeler using chassis dynamometer.
18. Schedule maintenance of two wheelers : oil level check, Oil top up, Oil change, Fuel filter replacement, Air filter checkup, Brake fluid check up, Radiator coolant top up, chain test.

Reference Books

1. Automobile Engineering , Vol 1 , Dr Kripal Singh , Standard Publishers distributors
2. Automobile Engineering , Vol 2 , Dr Kripal Singh , Standard Publishers distributors
3. Automobile Engineering Practical, N Malhotra , Asian Publishers
4. Vehicle service manuals of reputed manufacturers.
5. Automotive Mechanics , William H Crouse Donald L Anglin, Tata Mcgraw Hill Publishing

AUTOMOBILE ENGINEERING

CODE MEL203	COURSE NAME MATERIALS TESTING LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble:

The objective of this course is to give a broad understanding of common materials related to mechanical engineering with an emphasis on the fundamentals of structure-property-application and its relationships. A group of 6/7 students can conduct experiment effectively. A total of six experiments for the duration of 2 hours each is proposed for this course.

Prerequisite: A course on Engineering Mechanics is required

Course Outcomes:

After the completion of the course the student will be able to

CO 1	To understand the basic concepts of analysis of circular shafts subjected to torsion.
CO 2	To understand the behaviour of engineering component subjected to cyclic loading and failure concepts
CO 3	Evaluate the strength of ductile and brittle materials subjected to compressive, Tensile shear and bending forces
CO 4	Evaluate the microstructural morphology of ductile or brittle materials and its fracture modes (ductile /brittle fracture) during tension test
CO 5	To specify suitable material for applications in the field of design and manufacturing.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				3							
CO 2	3	3	1		3				3	2	2	1
CO 3	3	3	3	1	3				3	2	3	2
CO 4	3	3	3	3	3	2	2	1	3	2	3	2
CO 5	3	3	3	1	3	2	2	1	3	2	3	2

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30 marks

End Semester Examination Pattern:

The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipments and troubleshooting)	: 25 Marks
(d) Viva voce	: 20 marks
(e) Record	: 5 Marks

General instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

A minimum of 10 experiments are to be performed.

SYLLABUS

LIST OF EXPERIMENTS

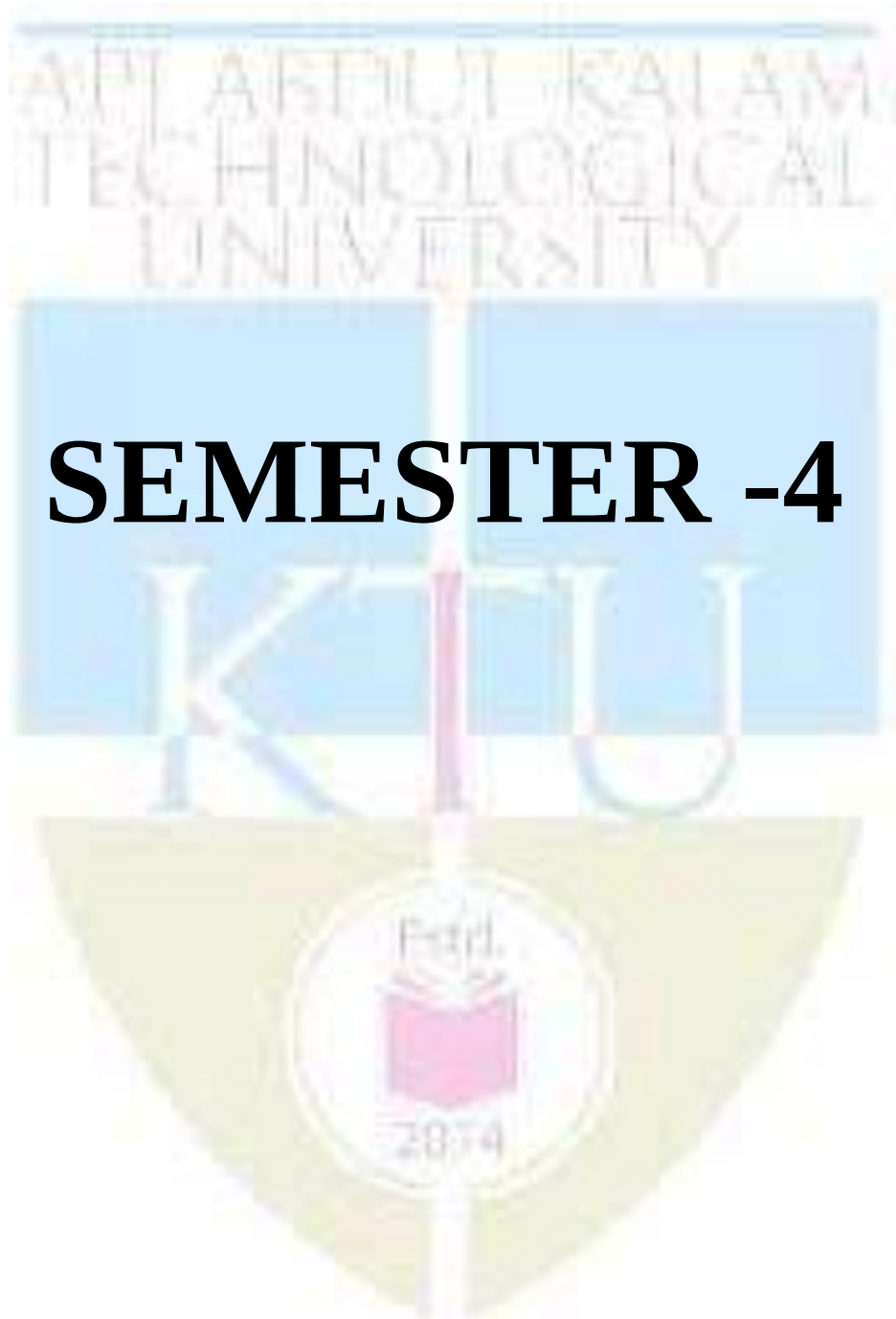
1. To conduct tension test on ductile material (mild steel/ tor-steel/ high strength steel) using Universal tension testing machine and Extensometer.
2. To conduct compression test on ductile material (mild steel/ tor-steel/ high strength steel) using Universal tension testing machine and Extensometer.
3. To conduct tension test on Brittle material (cast iron) using Universal tension testing machine and Extensometer.
4. To conduct shear test on mild steel rod.
5. To conduct microstructure features of mild steel/copper/ brass/aluminium using optical microscope, double disc polishing machine, emery papers and etchant.
6. To conduct fractography study of ductile or brittle material using optical microscope.

AUTOMOBILE ENGINEERING

7. To conduct Hardness test of a given material. (Brinell, Vickers and Rockwell)
8. To determine torsional rigidity of mild steel/copper/brass rod.
9. To determine flexural rigidity of mild steel/ copper/brass material using universal testing machine.
10. To determine fracture toughness of the given material using Universal tension testing machine.
11. To study the procedure for plotting S-N curve using Fatigue testing machine.
12. To conduct a Toughness test of the given material using Izod and Charpy Machine.
13. To determine spring stiffness of close coiled/open coiled/series/parallel arrangements.
14. To conduct bending test on wooden beam.
15. To conduct stress measurements using Photo elastic methods.
16. To conduct strain measurements using strain gauges.
17. To determine moment of inertia of rotating bodies.
18. To conduct an experiment to Verify Clerk Maxwell's law of reciprocal deflection and determine young's Modulus of steel.
19. To determine the surface roughness of a polished specimen using surface profilometer.

Reference Books

1. G E Dieter. Mechanical Metallurgy, McGraw Hill,2013
2. Dally J W, Railey W P, Experimental Stress analysis , McGarw Hill,1991
3. Baldev Raj, Jayakumar T, Thavasimuthu M., Practical Non destructive testing, Narosa Book Distributors,2015



SEMESTER -4

MATHEMATICS – 4 th semester

(All branches except Electrical, Electronics, Computer science, Information Technology and Applied Electronics)

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MAT 202	PROBABILITY, STATISTICS AND NUMERICAL METHODS	BASIC SCIENCE COURSE	3	1	0	4

Preamble: This course introduces students to the modern theory of probability and statistics, covering important models of random variables and techniques of parameter estimation and hypothesis testing. A brief course in numerical methods familiarises students with some basic numerical techniques for finding roots of equations, evaluating definite integrals solving systems of linear equations, and solving ordinary differential equations which are especially useful when analytical solutions are hard to find.

Prerequisite: A basic course in one-variable and multi-variable calculus.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the concept, properties and important models of discrete random variables and, using them, analyse suitable random phenomena.
CO 2	Understand the concept, properties and important models of continuous random variables and, using them, analyse suitable random phenomena.
CO 3	Perform statistical inferences concerning characteristics of a population based on attributes of samples drawn from the population
CO 4	Compute roots of equations, evaluate definite integrals and perform interpolation on given numerical data using standard numerical techniques
CO 5	Apply standard numerical techniques for solving systems of equations, fitting curves on given numerical data and solving ordinary differential equations.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	2	2					2		1
CO 2	3	2	2	2	2					2		1
CO 3	3	2	2	2	2					2		1
CO 4	3	2	2	2	2					2		1
CO 5	3	2	2	2	2					2		1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests(%)		End Semester Examination(%)
	1	2	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	10	10	10
Create			

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Let X denote the number that shows up when an unfair die is tossed. Faces 1 to 5 of the die are equally likely, while face 6 is twice as likely as any other. Find the probability distribution, mean and variance of X .
2. An equipment consists of 5 componets each of which may fail independently with probability 0.15. If the equipment is able to function properly when at least 3 of the componets are operational, what is the probability that it functions properly?
3. X is a binomial random variable $B(n, p)$ with $n = 100$ and $p = 0.1$. How would you approximate it by a Poisson random variable?
4. Three balls are drawn at random without replacement from a box containing 2 white, 3 red and 4 black balls. If X denotes the number of white balls drawn and Y denotes the number of red balls drawn, find the joint probability distribution of (X, Y)

Course Outcome 2 (CO2)

1. What can you say about $P(X = a)$ for any real number a when X is a (i) discrete random variable? (ii) continuous random variable?

2. A string, 1 meter long, is cut into two pieces at a random point between its ends. What is the probability that the length of one piece is at least twice the length of the other?
3. A random variable has a normal distribution with standard deviation 10. If the probability that it will take on a value less than 82.5 is 0.82, what is the probability that it will take on a value more than 58.3?
4. X and Y are independent random variables with X following an exponential distribution with parameter μ and Y following an exponential distribution with parameter k . Find $P(X + Y \leq 1)$

Course Outcome 3(CO3):

1. In a random sample of 500 people selected from the population of a city 60 were found to be left-handed. Find a 95% confidence interval for the proportion of left-handed people in the city population.
2. What are the types of errors involved in statistical hypothesis testing. Explain the level of risks associated with each type of error.
3. A soft drink maker claims that a majority of adults prefer its leading beverage over that of its main competitor's. To test this claim 500 randomly selected people were given the two beverages in random order to taste. Among them, 270 preferred the soft drink maker's brand, 211 preferred the competitor's brand, and 19 could not make up their minds. Determine whether there is sufficient evidence, at the 5% level of significance, to support the soft drink maker's claim against the default that the population is evenly split in its preference.
4. A nutritionist is interested in whether two proposed diets, *diet A* and *diet B* work equally well in providing weight-loss for customers. In order to assess a difference between the two diets, she puts 50 customers on diet A and 60 other customers on diet B for two weeks. Those on the former had weight losses with an average of 11 pounds and a standard deviation of 3 pounds, while those on the latter lost an average of 8 pounds with a standard deviation of 2 pounds. Do the diets differ in terms of their weight loss?

Course Outcome 4(CO4):

1. Use Newton-Raphson method to find a real root of the equation $f(x) = e^{zx} - x - 6$ correct to 4 decimal places.
2. Compare Newton's divided difference method and Lagrange's method of interpolation.

3. Use Newton's forward interpolation formula to compute the approximate values of the function f at $x = 0.25$ from the following table of values of x and $f(x)$

x	0	0.5	1	1.5	2
$f(x)$	1.0000	1.0513	1.1052	1.1618	1.2214

4. Find a polynomial of degree 3 or less the graph of which passes through the points $(-1,3)$, $(0,-4)$, $(1,5)$ and $(2,-6)$

Course Outcome 5 (CO5):

- Apply Gauss-Seidel method to solve the following system of equations

$$\begin{aligned} 4x_1 - x_2 - x_3 &= 3 \\ -2x_1 + 6x_2 + x_3 &= 9 \\ -x_1 + x_2 + 7x_3 &= -6 \end{aligned}$$
- Using the method of least squares fit a straight line of the form $y = ax + b$ to the following set of ordered pairs (x, y) :
 $(2,4)$, $(3,5)$, $(5,7)$, $(7,10)$, $(9,15)$
- Write the normal equations for fitting a curve of the form $y = a_0 + a_1x^2$ to a given set of pairs of data points.
- Use Runge-Kutta method of fourth order to compute $y(0.25)$ and $y(0.5)$, given the initial value problem
 $y' = x + xy + y$, $y(0) = 1$

Syllabus

Module 1 (Discrete probability distributions)

9 hours

(Text-1: Relevant topics from sections-3.1-3.4, 3.6, 5.1)

Discrete random variables and their probability distributions, Expectation, mean and variance, Binomial distribution, Poisson distribution, Poisson approximation to the binomial distribution, Discrete bivariate distributions, marginal distributions, Independent random variables, Expectation -multiple random variables.

Module 2 (Continuous probability distributions)

9 hours

(Text-1: Relevant topics from sections-4.1-4.4, 3.6, 5.1)

Continuous random variables and their probability distributions, Expectation, mean and variance, Uniform, exponential and normal distributions, Continuous bivariate distributions, marginal distributions, Independent random variables, Expectation-multiple random variables, i.i.d random variables and Central limit theorem (**without proof**).

Module 3 (Statistical inference)

9 hours

(Text-1: Relevant topics from sections-5.4., 3.6, 5.1, 7.2, 8.1, 8.3, 9.1-9.2, 9.4)

Population and samples, Sampling distribution of the mean and proportion (for large samples only), Confidence interval for single mean and single proportions (for large samples only). Test of hypotheses: Large sample test for single mean and single proportion, equality of means and equality of proportions of two populations, small sample t-tests for single mean of normal population, equality of means (**only pooled t-test, for independent samples from two normal populations with equal variance**)

Module 4 (Numerical methods -I)

9 hours

(Text 2- Relevant topics from sections 19.1, 19.2, 19.3, 19.5)

Errors in numerical computation-round-off, truncation and relative error, Solution of equations – Newton-Raphson method and Regula-Falsi method. Interpolation-finite differences, Newton's forward and backward difference method, Newton's divided difference method and Lagrange's method. Numerical integration-Trapezoidal rule and Simpson's 1/3rd rule (**Proof or derivation of the formulae not required for any of the methods in this module**)

Module 5 (Numerical methods -II)

9 hours

(Text 2- Relevant topics from sections 20.3, 20.5, 21.1)

Solution of linear systems-Gauss-Siedal and Jacobi iteration methods. Curve fitting-method of least squares, fitting straight lines and parabolas. Solution of ordinary differential equations-Euler and Classical Runge-Kutta method of second and fourth order, Adams-Moulton predictor-correction method (**Proof or derivation of the formulae not required for any of the methods in this module**)

Text Books

1. (Text-1) Jay L. Devore, *Probability and Statistics for Engineering and the Sciences*, 8th edition, Cengage, 2012
2. (Text-2) Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th Edition, John Wiley & Sons, 2016.

Reference Books

1. Hossein Pishro-Nik, *Introduction to Probability, Statistics and Random Processes*, Kappa Research, 2014 (Also available online at www.probabilitycourse.com)
2. Sheldon M. Ross, *Introduction to probability and statistics for engineers and*

- scientists, 4th edition, Elsevier, 2009.
3. T. Veera Rajan, *Probability, Statistics and Random processes*, Tata McGraw-Hill, 2008
 4. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 36 Edition, 2010.

Assignments

Assignments should include specific problems highlighting the applications of the methods introduced in this course in physical sciences and engineering.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Discrete Probability distributions	9 hours
1.1	Discrete random variables and probability distributions, expected value, mean and variance (discrete)	3
1.2	Binomial distribution-mean, variance, Poisson distribution-mean, variance, Poisson approximation to binomial	3
1.3	Discrete bivariate distributions, marginal distributions, Independence of random variables (discrete), Expected values	3
2	Continuous Probability distributions	9 hours
2.1	Continuous random variables and probability distributions, expected value, mean and variance (continuous)	2
2.2	Uniform, exponential and normal distributions, mean and variance of these distributions	4
2.3	Continuous bivariate distributions, marginal distributions, Independent random variables, Expected values, Central limit theorem.	3
3	Statistical inference	9 hours
3.1	Population and samples, Sampling distribution of single mean and single proportion(large samples)	1
3.2	Confidence interval for single mean and single proportions (large samples)	2
3.3	Hypothesis testing basics, large sample test for single proportion, single proportion	2
3.4	Large sample test for equality of means and equality of proportions of two populations	2

3.5	t-distribution and small sample t-test for single mean and pooled t-test for equality of means	2
4	Numerical methods-I	9 hours
4.1	Roots of equations- Newton-Raphson, regulafalsi methods	2
4.2	Interpolation-finite differences, Newton's forward and backward formula,	3
4.3	Newton's divided difference method, Lagrange's method	2
4.3	Numerical integration-trapezoidal rule and Simpson's 1/3-rd rule	2
5	Numerical methods-II	9 hours
5.1	Solution of linear systems-Gauss-Siedal method, Jacobi iteration method	2
5.2	Curve-fitting-fitting straight lines and parabolas to pairs of data points using method of least squares	2
5.3	Solution of ODE-Euler and Classical Runge-Kutta methods of second and fourth order	4
5.4	Adams-Moulton predictor-corrector methods	1

Model Question Paper

(2019 Scheme)

Reg No:

Total Pages: 4

Name:

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION

(Month & year)

Course Code: MAT

Course Name: PROBABILITY, STATISTICS AND NUMERICAL METHODS

(Common to all branches except (i) Electrical and Electronics, (ii) Electronics and Communication, (iii) Applied Electronics and Instrumentation (iv) Computer Science and Engineering (v) Information Technology)

Max Marks :100

Duration : 3 Hours

PART A

(Answer all questions. Each question carries 3 marks)

- Suppose X is binomial random variable with parameters $n = 100$ and $p = 0.02$. Find $P(X < 3)$ using Poisson approximation to X . (3)
- The diameter of circular metallic discs produced by a machine is a random variable with mean 6cm and variance 2cm. Find the mean area of the discs. (3)
- Find the mean and variance of the continuous random variable X with probability density function (3)

$$f(x) = \begin{cases} 2x - 4, & 2 \leq x \leq 3 \\ 0 & \text{otherwise} \end{cases}$$
- The random variable X is exponentially distributed with mean 3. Find $P(X > t + 3 | X > t)$ where t is any positive real number. (3)
- The 95% confidence interval for the mean mass (in grams) of tablets produced by a machine is [0.56 0.57], as calculated from a random sample of 50 tablets. What do you understand from this statement? (3)
- The mean volume of liquid in bottles of lemonade should be at least 2 litres. A sample of bottles is taken in order to test whether the mean volume has fallen below 2 litres. Give a null and alternate hypothesis for this test and specify whether the test would be one-tailed or two-tailed. (3)
- Find all the first and second order forward and backward differences of y for the following set of (x, y) values: (0.5, 1.13), (0.6, 1.19), (0.7, 1.26), (0.8, 1.34) (3)
- The following table gives the values of a function $f(x)$ for certain values of x . (3)

x	0	0.25	0.50	0.75	1
$f(x)$	1	0.9412	0.8	0.64	0.5

Evaluate $\int_0^1 f(x)dx$ using trapezoidal rule.

- Explain the principle of least squares for determining a line of best fit to a given data (3)
- Given the initial value problem $y' = y + x$, $y(0) = 0$, find $y(0.1)$ and $y(0.2)$ using Euler method. (3)

PART B
(Answer one question from each module)
MODULE 1

11. (a) The probability mass function of a discrete random variable is $p(x) = kx$, $x = 1, 2, 3$ where k is a positive constant. Find (i) the value of k (ii) $P(X \leq 2)$ (iii) $E[X]$ and (iv) $\text{var}(1 - X)$. (7)
- (b) Find the mean and variance of a binomial random variable (7)

OR

12. (a) Accidents occur at an intersection at a Poisson rate of 2 per day. what is the probability that there would be no accidents on a given day? What is the probability that in January there are at least 3 days (not necessarily consecutive) without any accidents? (7)
- (b) Two fair dice are rolled. Let X denote the number on the first die and $Y = 0$ or 1 , according as the first die shows an even number or odd number. Find (i) the joint probability distribution of X and Y , (ii) the marginal distributions. (iii) Are X and Y independent ? (7)

MODULE 2

13. (a) The IQ of an individual randomly selected from a population is a normal distribution with mean 100 and standard deviation 15. Find the probability that an individual has IQ (i) above 140 (ii) between 120 and 130. (7)
- (b) A continuous random variable X is uniformly distributed with mean 1 and variance $4/3$. Find $P(X < 0)$ (7)

OR

14. (a) The joint density function of random variables X and Y is given by (7)
- $$f(x, y) = \begin{cases} e^{-(x+y)}, & x > 0, \quad y > 0 \\ 0 & \text{otherwise.} \end{cases}$$

Find $P(X + Y \leq 1)$. Are X and Y independent? Justify.

- (b) The lifetime of a certain type of electric bulb may be considered as an exponential random variable with mean 50 hours. Using central limit theorem, find the approximate probability that 100 of these electric bulbs will provide a total of more than 6000 hours of burning time. (7)

MODULE 3

15. (a) The mean blood pressure of 100 randomly selected persons from a target population is 127.3 units. Find a 95% confidence interval for the mean blood pressure of the population. (7)
- (b) The CEO of a large electric utility claims that 80 percent of his 1,000,000 customers are very satisfied with the service they receive. To test this claim, the local newspaper surveyed 100 customers, using simple random sampling. Among the sampled customers, 73 percent say they are very satisfied. Based on these findings, do you think that the CEO is making a false claim of high satisfaction levels among his customers? Use a 0.05 level of significance. (7)

OR

16. (a) A magazine reported the results of a telephone poll of 800 adult citizens of a country. The question posed was: "Should the tax on cigarettes be raised to pay for health care reform?" The results of the survey were: Out of the 800 persons surveyed, 605 were non-smokers out of which 351 answered "yes" and the rest "no". Out of the remaining 195, who were smokers, 41 answered "yes" and the remaining "no". Is there sufficient evidence, at the 0.05 significance level, to conclude that the two populations smokers and non-smokers differ significantly with respect to their opinions? (7)
- (b) Two types of cars are compared for acceleration rate. 40 test runs are recorded for each car and the results for the mean elapsed time recorded below: (7)

	Sample mean	Sample standard deviation
Car A	7.4	1.5
Car B	7.1	1.8

determine if there is a difference in the mean elapsed times of the two car models at 95% confidence level.

MODULE 4

17. (a) Use Newton-Raphson method to find a non-zero solution of $x = 2 \sin x$. Start with $x_0 = 1$ (7)
- (b) Using Lagrange's interpolating polynomial estimate $f(1.5)$ for the following data (7)

x	0	1	2	3
$y = f(x)$	0	0.9826	0.6299	0.5532

OR

18. (a) Consider the data given in the following table (7)

x	0	0.5	1	1.5	2
$f(x)$	1.0000	1.0513	1.1052	1.1618	1.2214

Estimate the value of $f(1.80)$ using Newton's backward interpolation formula.

- (b) Evaluate $\int_0^1 e^{-x^2/2} dx$ using Simpson's one-third rule, dividing the interval $[0, 1]$ into 8 subintervals (7)

MODULE 5

19. (a) Using Gauss-Seidel method, solve the following system of equations (7)

$$\begin{aligned} 20x + y - 2z &= 17 \\ 3x + 20y - z &= -18 \\ 2x - 3y + 20z &= 25 \end{aligned}$$

- (b) The table below gives the estimated population of a country (in millions) for during 1980-1995 (7)

year	1980	1985	1990	1995
population	227	237	249	262

Plot a graph of this data and fit an appropriate curve to the data using the method of least squares. Hence predict the population for the year 2010.

OR

20. (a) Use Runge-Kutta method of fourth order to find $y(0.2)$ given the initial value problem (7)

$$\frac{dy}{dx} = \frac{xy}{1+x^2}, \quad y(0) = 1$$

Take step-size, $h = 0.1$.

- (b) Solve the initial value problem (7)

$$\frac{dy}{dx} = x + y, \quad y(0) = 0,$$

in the interval $0 \leq x \leq 1$, taking step-size $h = 0.2$. Calculate $y(0.2)$, $y(0.4)$ and $y(0.6)$ using Runge-Kutta second order method, and $y(0.8)$ and $y(1.0)$ using Adam-Moulton predictor-corrector method.

AUTOMOBILE ENGINEERING

AUT 202	FLUID MECHANICS AND MACHINERY	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: The aim of this subject is to offer the students a general understanding of Fluid Mechanics & Machinery.

- ✓ To introduce students, the fundamental concepts related to the mechanics of fluids.
- ✓ The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.
- ✓ To understand the basic principles of fluid machines and devices.
- ✓ To understand the importance of boundary layer theory
- ✓ To understand the importance of various types of flow in pumps and turbines

Prerequisite:

Course Outcomes: After the completion of the course the student will be able to

CO 1	Become conversant with the principles of hydrostatics.
CO 2	Understand the concept of fluid statics
CO 3	Calculate pressure variations in accelerating fluids using Euler's and Bernoulli's equations and become conversant with the concepts of flow measurements and flow through pipes
CO 4	Calculate forces and work done by a jet on fixed or moving plate and curved plates and understand
CO 5	Discuss the characteristics of centrifugal pump and reciprocating pumps.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	1	-	-	1	-	-	-	-	-	-
CO 2	2	-	-	-	-	1	-	-	-	-	-	-
CO 3	2	1	-	-	-	1	-	-	-	-	-	-
CO 4	3	2	2	-	-	1	-	-	-	-	-	-
CO 5	3	1	2	-	-	2	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 5 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 10 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Become conversant with the principles of hydrostatics.

Course Outcome 2 (CO2)

1. Understand the concept of fluid statics

Course Outcome 3(CO3):

1. Calculate pressure variations in accelerating fluids using Euler's and Bernoulli's equations and become conversant with the concepts of flow measurements and flow through pipes

Course Outcome 4 (CO4):

1. Calculate forces and work done by a jet on fixed or moving plate and curved plates and

Course Outcome 5 (CO5):

1. Discuss the characteristics of centrifugal pump and reciprocating pumps.

Model Question paper

QP CODE: _____ **PAGES:3**

Reg. No: _____ **Name :** _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT 202

Course Name: FLUID MECHANICS AND MACHINERY

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer all Questions.

Each question carries 5 Marks (2 questions from each module)

1. Define the following fluid properties i. Mass density ii. Specific weight
2. State Pascal's Law
3. Explain Hagen-Poiseuille equation.
4. Compare impulse and reaction turbines.
5. What is the purpose of draft tube in a reaction turbine?
6. What is the function of spear in Pelton wheel?
7. Why do we use air vessels in reciprocating pumps?
8. Explain the working of a double acting reciprocating pump.
9. Define stream line, streak line, path line and stream tube.
10. Explain design features of Pelton wheel

PART B

Answer any one full question from each module.

Each question carries 10 Marks

Module 1

11. Explain the characteristic fluid properties to which the following phenomenon are attributable

- (i) Rise of sap in a tree
- (ii) Spherical shape of a drop of a liquid
- (iii) Cavitation
- (iv) Flow of a jet of oil in an unbroken stream
- (v) Water hammer

(10)

Or

12. The left limb of a simple U Tube manometer containing mercury is open to atmosphere while the right limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 15 cm below the level of mercury in the left limb. Find the pressure of fluid in the pipe if the difference of mercury level in two limbs is 24 cm.

(10)

Module 2

13. Derive Euler's equation of motion and list down the assumptions made in it. (10)

Or

14. Define the following

- i. Laminar boundary layer
- ii. Turbulent boundary layer

iii. Boundary layer thickness

(10)

Module 3

15. The dynamic viscosity of an oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4m and rotates at 190 r.p.m. Calculate the power lost in the bearing for a sleeve length of 90mm. the thickness of the oil film is 1.5mm. (10)

Or

16. What is the difference between a laminar flow and turbulent flow? (10)

Module 4

- 17 With neat sketches, derive the continuity equation for a jet flow. (10)

Or

18. A Pelton wheel has a mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 litres/sec under a head of 30m. The buckets deflect the jet through an angle of 160 degree. Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98. (10)

Module 5

19. A single acting reciprocating pump, running at 50 r.p.m delivers $0.01\text{m}^3/\text{s}$ of water. The diameter of the piston is 200mm and stroke length 400mm. Determine:
- i) The theoretical discharge of the pump. ii) Co-efficient of discharge
 - iii) Slip and percentage slip of the pump. (10)

Or

20. Explain with neat sketches Gear pump , vane pump

(10)

SYLLABUS

Module 1

Fundamental concepts: Properties of fluid - density, specific weight, viscosity, surface tension, capillarity, vapour pressure, bulk modulus, compressibility, velocity, rate of shear strain, Newton's law of viscosity, Newtonian and non-Newtonian fluids, real and ideal fluids, incompressible and compressible fluids. Fluid statics: Atmospheric pressure, gauge pressure and absolute pressure. Pascal's Law, measurement of pressure - piezo meter, manometers, pressure gauges, energies in flowing fluid, head - pressure, dynamic, static and total head, forces on planar and curved surfaces immersed in fluids, centre of pressure, buoyancy, equilibrium of floating bodies, metacentre and metacentric height.

Module 2

Fluid kinematics: Eulerian and Lagrangian approaches, classification of fluid flow, 1-D, 2-D and 3-D flow, steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational, irrotational flows, stream lines, path lines, streak lines, stream tubes, velocity and acceleration in fluid, circulation and vorticity, stream function and potential function, Laplace equation, equipotential lines flow nets, uses and limitations

Module 3

Fluid Dynamics: Dynamics of Fluid flow: Fluid Dynamics: Energies in flowing fluid, head, pressure, dynamic, static and total head, Control volume analysis of mass, momentum and energy, Equations of fluid dynamics: (Euler's equation), Navier-Stokes equations Bernoulli's equation and its applications: Venturimeters and Orifice meters, Notches and Weirs, Hydraulic coefficients, Velocity measurements: Pitot tube and Pitot-static tube Flow through pipes: Laminar and Turbulent flow, Reynold's experiment, loss of head due to friction, Darcy – Weishbach Equation, Chezy's formula, Minor losses in pipes. Hydraulic Gradient and Total Energy Lines

Module 4

Impact of jets Turbines: Impact of jet on vanes, flat, curved, stationary and moving vanes, continuity equation and momentum equation Hydraulic Turbines: classification, velocity triangle for Pelton wheel and Francis turbine, work done and efficiency, specific speed, draft tube, tail race, pen stock, water hammer, surge tank, governing, cavitation, selection of water turbines for power plants.

Module 5

Pumps: Classifications-types of casing and impellers, Velocity triangle for pumps, Head of pump, Losses and efficiency, Minimum starting speed, Specific speed, NPSH, Multistage pump, Pumps in parallel and series, selection of pumps. Positive displacement pumps – working principle, types of reciprocating pumps, Indicator diagram- work done, effect of acceleration and frictional resistance,

AUTOMOBILE ENGINEERING

slip and coefficient of discharge., separation in suction and delivery pipes, Air vessel, Gear pump, Lobe pump, Vane pump, Screw pump.

Text Books

1	Hydraulics & Fluid Mechanics	Modi P. N. and S. M. Seth	Standard Book House
2	Fluid Mechanics and Fluid Power Engineering	Kumar D. S	S. K. Kataria & Sons, New Delhi

Reference Books

Fluid Mechanics	J. F. Douglas	Pearson education.
Essentials of Fluid Mechanics: Fundamentals and Applications	John M. Cimbala, Yunus A. Cengel	Tata McGraw Hill
Introduction to fluid dynamics	Robert W. Fox and Mc Donald	John Wiley and sons

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Module 1 (9 hours)	
1.1	Properties of fluid - density, specific weight, viscosity, surface tension, capillarity, vapour pressure, bulk modulus, compressibility, velocity, rate of shear strain, Newton's law of viscosity, Newtonian and non-Newtonian fluids, real and ideal fluids, incompressible and compressible fluids.	2
1.2	Fluid statics: Atmospheric pressure, gauge pressure and absolute pressure, Pascal's Law.	1
1.3	Measurement of pressure - piezo meter, manometers, pressure gauges.	1
1.4	Energies in flowing fluid, head - pressure, dynamic, static and total head.	1
1.5	Forces on planar and curved surfaces immersed in fluids, centre of pressure.	2

AUTOMOBILE ENGINEERING

1.6	Buoyancy, equilibrium of floating bodies, metacentre and metacentric height.	2
2	Module 2 (7 hours)	
2.1	Eulerian and Lagrangian approaches, classification of fluid flow, 1-D, 2-D and 3-D flow, steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational, irrotational flows.	2
2.2	Stream lines, path lines, streak lines, stream tubes, velocity and acceleration in fluid.	2
2.3	Circulation and vorticity, stream function and potential function, Laplace equation, equipotential lines flow nets, uses and limitations.	3
3	Module 3 (11 hours)	
3.1	Fluid Dynamics: Energies in flowing fluid, head, pressure, dynamic, static and total head, Control volume analysis of mass, momentum and energy.	2
3.2	Equations of fluid dynamics: (Euler's equation), Navier-Stokes equations Bernoulli's equation.	2
3.3	Venturimeters, Orifice meters, Notches and Weirs, Hydraulic coefficients, Velocity measurements: Pitot tube and Pitot-static tube.	2
3.4	Laminar and Turbulent flow, Reynold's experiment, loss of head due to friction, Darcy – Weishbach Equation.	2
3.5	Chezy's formula, Minor losses in pipes. Hydraulic Gradient and Total Energy Lines.	3
4	Module 4 (9 hours)	
4.1	Impact of jet on vanes, flat, curved, stationary and moving vanes, continuity equation and momentum equation.	4
4.2	Classification, velocity triangle for Pelton wheel and Francis turbine, work done and efficiency.	3
4.3	Specific speed, draft tube, tail race, pen stock, water hammer, surge tank, governing, cavitation, selection of water turbines for power plants.	2
5	Module 5 (9 hours)	
5.1	Classifications-types of casing and impellers, Velocity triangle for pumps, Head of pump, Losses and efficiency, Minimum starting speed, Specific speed, NPSH, Multistage pump, Pumps in parallel and series, selection of pumps.	4

AUTOMOBILE ENGINEERING

5.2	Positive displacement pumps – working principle, types of reciprocating pumps, Indicator diagram- work done, effect of acceleration and frictional resistance, slip and coefficient of discharge., separation in suction and delivery pipes, Air vessel.	4
5.3	Gear pump, Lobe pump, Vane pump, Screw pump.	1



AUTOMOBILE ENGINEERING

AUT 204	AUTO POWER PLANT	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: The aim of this subject is to offer the students a general understanding of various I C Engines.

- ✓ Explain need, constructional details and working of various auxiliary system used for internal
- ✓ combustion engine, scavenging systems for two stroke engines
- ✓ To impart basic knowledge about fuel supply system in IC engines,
- ✓ To impart basic concepts of SI Engine, C.I. Engines and Combustion, automotive engines
- ✓ To know about SI Engine & CI engine emissions and their treatments
- ✓ To know about effect of supercharging and turbocharging on engine performance
- ✓ To understand lubrication, cooling, ignition and fuel systems in SI engines & C.I Engines

Prerequisite:

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand constructional details and working of various internal combustion engine
CO 2	Discuss the fuel system of IC engines
CO 3	Explain CI Engine & SI Engine and Combustion process
CO 4	Explain engine pollutants and its remedial
CO 5	Understand and analyse the Cooling and lubrication system for internal combustion engine

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	1	-	-	-	-	-	1	1	-	-
CO 2	3	-	-	-	-	1	-	-	-	-	-	-
CO 3	3	2	-	-	-	1	-	-	-	-	1	-
CO 4	3	-	-	-	-	2	1	-	-	1	-	-

AUTOMOBILE ENGINEERING

CO 5	3	-	-	-	-	3	2	-	-	-	1	-
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Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 5 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 10 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the Constructional, design and working principles of I.C. Engines
2. Explain Applications of IC Engines.

Course Outcome 2 (CO2)

1. Explain the fuel system of IC engines
2. Explain maximum and minimum speed governors
3. Explain Heavy duty air filters, diesel filters, cold starting devices.

Course Outcome 3(CO3):

1. Determine the air fuel ratio for different fuels.
2. Explain the P-θ diagram and Stages of combustion
3. Explain Combustion chambers for SI and CI engines

Course Outcome 4 (CO4):

1. Explain the Supercharging and Turbocharging,
2. Explain the Pollutants in SI and CI engines.
3. Explain Dynamometers, Engine testing standards thermal and volumetric efficiencies

Course Outcome 5 (CO5):

1. Discuss the cooling systems
2. Explain the lubrication systems.
3. Explain the Valve & Port timing diagrams.

Model Question paper

QP CODE:

PAGES:3

Reg. No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT 204

Course Name: AUTO POWER PLANT

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

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Each question carries 5 Marks (2 questions from each module)

1. Differentiate between forced and thermo-siphon cooling system
2. What are the disadvantages of overcooling?
3. What is the necessity of engine cooling?
4. What are the desirable properties of engine lubricating oil?
5. Explain the basic principle of lubrication?
6. Discuss the stages of combustion in C.I. Engine
7. Mention the different types of combustion chambers in C.I Engines
8. What are the basic requirements of diesel injection systems?
9. explain various types of fuel nozzles
10. What are the different types of Air filters in C I engines?

PART B

Answer any one full question from each module.

Each question carries 10 Marks

Module 1

11. Explain the working of two stroke and 4 stroke engines (10)

Or

12. Explain the constructional details of following components
- a. connecting rod (5)
 - b. crank shaft (5)

Module 2

13. Describe different types of diesel injection system? (10)

Or

14. Briefly explain the different systems in MPFI system with neat sketch. (10)

Module 3

15. Explain the stages of combustion for SI engines and discuss the effect of various parameters affecting them (10)

Or

16. Explain the different types of combustion chambers for CI engines (10)

Module 4

- 17.
- a. What is supercharging? State its objectives? (4)
 - b. With the help of neat sketches explain any two methods of supercharging (6)

Or

- 18.
- a. What are the non – exhaust emissions in an IC engine? (5)
 - b. What is the function of particulate traps in CI engines? (5)

Module 5

19. Explain the different properties of lubricating oils (10)

Or

20. a. Explain the necessity of engine cooling with the effect different operating parameters leading to effective cooling of engine (5)
- b. Explain different types of Cooling system (5)

SYLLABUS

Module 1

Introduction: Basic engine nomenclature, classification of I.C engines. Working of two stroke and 4 stroke with relative merits and demerits. Firing order, Constructional details of engine components: Cylinders – types, cylinder liners, engine block, types of cylinder head, gasket materials, and piston - types, materials, piston rings, piston pins, connecting rod, crank shaft, flywheel, cam shaft, valve and valve mechanism, inlet and exhaust manifold construction, hydraulic tappets. Applications of IC Engines.

Module 2

Fuel supply system in SI Engines & CI Engines: Air fuel mixture requirements and types, effect of air fuel mixture on performance, quality rating petrol and diesel fuels. Types of fuel feed systems, fuel tank, fuel pumps and fuel filters (types and construction), air filter types. Carburetion, simple carburettor, limitation of carburetor type fuel supply system, Fuel injection system - GDI, MPFI and relative merits. Fuel supply system in diesel engines: components of diesel fuel system, feed pump, injection pump & types, functions and necessity, Electronic Unit Injectors (EUI) maximum and minimum speed governors, injection nozzles and types. Heavy duty air filters, diesel filters, cold starting devices. CRDI system

Module 3

COMBUSTION AND COMBUSTION CHAMBERS: Thermodynamic of combustion, calculation of air fuel ratio for different fuels. Introduction to combustion in SI and CI engines. P- θ diagram Stages of combustion description, factors affecting petrol and diesel engine. Abnormal combustion in petrol and diesel engines, knocking controls for both engines. Combustion chambers for SI and CI engines. Importance of Swirl, Squish and Turbulence. Design Factors of combustion chamber.

Module 4

SUPERCHARGING, TURBO CHARGING AND ENGINE TESTING: Supercharging and Turbocharging, Different types of turbocharging, intercooling, wastegate, variable geometry. Pollutants in SI and CI engines. Types of emissions Measurement of exhaust emissions (HC, CO, NOx

AUTOMOBILE ENGINEERING

and smoke intensity) Exhaust gas Treatments- Canister, Catalytic converter, Thermal Reactor, Particulate trap Positive Crankcase Ventilation. Dynamometers, Engine testing standards thermal and volumetric efficiencies. Heat balance test Measurement of friction, Cylinder pressure measurement

Module 5

COOLING AND LUBRICATION SYSTEMS: Need for cooling, types of cooling systems- air and liquid cooling systems. Water cooling circuit, radiator, water pump and cooling fan. Properties of coolants and additives. Requirements of lubrication systems. Types of Lubrication system, (dry and wet sump systems). Properties and chemistry of lubricants. SAE Ratings Multigrade lubricants, Pre-lubrication systems Valve and valve mechanism - OHV, OHC, DOHC, variable valve timing systems. Valve Timing Diagram, Port timing diagrams, Symmetrical & unsymmetrical timing Exhaust mufflers, Type of mufflers.

Text Books

1	Internal Combustion Engines	Ganesan. V	Tata McGraw-Hill Publishing Co
2	Internal Combustion Engines	Ramalingam K.K	Sci-Tech Publications
3	Internal Combustion Engines	R.K. Rajput	Laxmi Publications.

Reference Books

4	A course in internal combustion engines	Mathur. M.L., Sharma. R.P	Dhanpatrai publication
5	Internal Combustion Engines Fundamentals	John Heywood	McGraw Hill International Edition
6	Fuels & Combustion	Smith, Marion L. And Karl W. Stinson	McGraw-Hill

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Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Introduction Module 1 (9 hours)	
1.1	Basic engine nomenclature, classification of I.C engines.	1
1.2	Working of two stroke and 4 stroke with relative merits and demerits.	2
1.3	Firing order, Constructional details of engine components: Cylinders – types, cylinder liners, engine block, types of cylinder head, gasket materials, and piston - types, materials, piston rings, piston pins, connecting rod, crank shaft, flywheel, cam shaft,	3
1.4	Valve and valve mechanism, inlet and exhaust manifold construction, hydraulic tappets.	2
1.5	Applications of IC Engines.	1
2	Fuel supply system in SI Engines& CI Engines Module 2 (9 hours)	
2.1	Air fuel mixture requirements and types, effect of air fuel mixture on performance, quality rating petrol and diesel fuels.	1
2.2	Types of fuel feed systems, fuel tank, fuel pumps and fuel filters (types and construction), air filter types Carburetion, simple carburetor, limitation of carburetor type fuel supply system	1
2.4	Fuel injection system - GDI, MPFI and relative merits.	1
2.5	Fuel supply system in diesel engines: components of diesel fuel system, feed pump, injection pump & types, functions, and necessity	2
2.6	Electronic Unit Injectors (EUI) maximum and minimum speed governors, injection nozzles and types	2
2.7	Heavy duty air filters, diesel filters, cold starting devices. CRDI system	2
3	COMBUSTION AND COMBUSTION CHAMBERS Module 3 (9 hours)	
3.1	Thermodynamic of combustion, calculation of air fuel ratio for different fuels.	2
3.2	Introduction to combustion in SI and CI engines. P- θ diagram Stages of combustion description, factors affecting petrol and diesel engine.	2
3.3	Abnormal combustion in petrol and diesel engines, knocking controls for both engines.	2
3.4	Combustion chambers for SI and CI engines. Importance of Swirl,	3

AUTOMOBILE ENGINEERING

	Squish and Turbulence. Design Factors of combustion chamber.	
4	SUPERCHARGING, TURBO CHARGING AND ENGINE TESTING Module 4 (9hours)	
4.1	Supercharging and Turbocharging, Different types of turbocharging, intercooling, wastegate, variable geometry.	3
4.2	Pollutants in SI and CI engines. Types of emissions Measurement of exhaust emissions (HC, CO, NO _x and smoke intensity) Exhaust gas Treatments- Canister, Catalytic converter, Thermal Reactor, Particulate trap Positive Crankcase Ventilation.	3
4.3	Dynamometers, Engine testing standards thermal and volumetric efficiencies. Heat balance test Measurement of friction, Cylinder pressure measurement	3
5	COOLING AND LUBRICATION SYSTEMS Module 5 (9 hours)	
5.1	Need for cooling, types of cooling systems- air and liquid cooling systems. Water cooling circuit, radiator, water pump and cooling fan. Properties of coolants and additives.	2
5.2	Requirements of lubrication systems. Types of Lubrication system, (dry and wet sump systems). Properties and chemistry of lubricants Ratings Multigrade lubricants, Pre-lubrication systems	3
5.3	Valve and valve mechanism - OHV, OHC, DOHC, variable valve timing systems. Valve Timing Diagram	2
5.4	Port timing diagrams, Symmetrical & unsymmetrical timing Exhaust mufflers, Type of mufflers.	2

AUTOMOBILE ENGINEERING

AUT 206	AUTOMOTIVE TRANSMISSION	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: The aim of this subject is to offer the students a general understanding of various automotive transmissions.

- ✓ To impart basic knowledge in automotive transmission.
- ✓ To understand the construction and principle of operation of various types of mechanical transmission components.
- ✓ To determine the gear ratio and number of teeth on driving and driven gears.
- ✓ To understand necessity, advantages, constructional and principle of operation of different types of automatic transmissions and hydraulic control.
- ✓ To understand the basics of electric drive.
- ✓ To understand the construction and operation of various types of hydrodynamic devices and hydrostatic devices

Prerequisite:

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the Constructional, design and working principles of different types of clutches, fluid couplings, torque convertors, different gear box etc.
CO 2	Determine the gear ratio, speed of vehicle and number of teeth on driving and driven gears.
CO 3	Explain the constructional and principle of operation of different types epicyclic gear box, Calculation of gear ratio for epicyclic gear box.
CO 4	Explain the necessity, advantages, constructional and principle of operation of different types of automatic transmissions and hydraulic control.
CO 5	Compare various types of Hydrostatic drives, explain the principle of operation, advantages and limitations of electric drive.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	2	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 5 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 10 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the Constructional, design and working principles of different types of clutches
2. Explain constructional details of fluid couplings, torque convertors

Course Outcome 2 (CO2)

1. Explain constructional details of different gear boxes
2. Determine the gear ratio.
3. Determine speed of vehicle and number of teeth on driving and driven gears.

Course Outcome 3(CO3):

1. Explain the construction of Simple epicyclic gear train
2. Explain the Construction and operation of Ford – T-model gearbox, Wilson Gear box and electromagnetic transmission
- 3 .Explain the construction and working of Fluid coupling and Torque converter.
4. Constructional details of Multistage torque converters, Polyphase torque converters , Converter coupling .

Course Outcome 4 (CO4):

1. Explain the need for automatic transmission
2. Explain the operation of Hydraulic control system for automatic transmission
3. Working of Chevrolet “Turboglide” Transmission, Continuously Variable Transmission (CVT) – Types

Course Outcome 5 (CO5):

1. Discuss on Hydrostatic drive - Various types of hydrostatic systems, Principles of Hydrostatic drive system. Advantages and limitations.
2. To compare hydrostatic drive with hydrodynamic drive
- 3 To explain the Principle of operation of Early and Modified Ward Leonard Control system, Advantages & limitations..

Model Question paper

QP CODE:

Reg. No: _____

PAGES:3

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

Course Code: AUT 206

Course Name: AUTOMOTIVE TRANSMISSION

Max. Marks: 100

Duration:3Hours

PART A

Answer all Questions.

Each question carries 5 Marks (2 questions from each module)

1. Explain the term Tractive effort
2. Explain with a neat diagram the working of centrifugal clutch
3. What are the advantages of constant mesh gearbox when compared to sliding mesh gearbox?

AUTOMOBILE ENGINEERING

4. Explain the different shifting patterns used in an automobile for the shifting of gears
5. Explain the characteristics of a typical torque converter with neat graphs
6. List down the advantages and disadvantages of a fluid flywheel when compared to a torque converter
7. Compare hydrostatic and hydrodynamic transmission systems
8. Compare hydrostatic and conventional manual transmission systems
9. With a neat sketch explain the constructional details of a constant mesh gear box.
10. Why double de clutching is needed for sliding mesh and constant mesh gear box..

PART B

**Answer any one full question from each module.
Each question carries 10 Marks**

Module 1

11. Explain the working of a centrifugal clutch (10)

Or

12. a. What are the characteristics of a multi-plate clutch v (6)
b. Compare cone clutch and diaphragm clutch (4)

Module 2

13. Explain the working of a constant mesh gear box with neat sketches. (10)

Or

- 14 Why Double de clutching is needed in constant mesh gear box? Why it is not needed in synchromesh? Explain? (10)

Module 3

15. With neat sketch explain the construction of a Ford-T-model gear box. (10)

Or

16. With a neat sketch explain the principle operation of a fluid flywheel. Also give the characteristic curves. (10)

Module 4

- 17 Explain the working of a CVT. (10)

Or

18. a) Write down the necessity of an automatic transmission. (2)
b) Explain the principle of operation of an automatic transmission (8)

Module 5

19. Give an account of various types of hydrostatic drives. (10)

Or

- 20 Explain the principle of operation of a Ward Leonard model Control system. (10)

SYLLABUS

Module 1

Introduction: Performance of automobile - such as resistance to motion, tractive effort, engine speed, engine power and acceleration. Requirement of transmission system.

Clutches: Different types of clutches - principle, construction and torque capacity, simple problems on clutches.

Module 2

Determination of gear ratios for vehicles. Different types of gearboxes such as Sliding mesh gearbox, Constant mesh gearbox and Synchromesh gearbox, gear shifting mechanisms .Simple problems.

Module 3

Simple epicyclic gear train, Construction and operation of Ford – T-model gearbox, Wilson Gear box and electromagnetic transmission.

Principle of operation, Constructional details, Performance characteristics – Fluid coupling and Torque converter. Constructional details of Multistage torque converters, Polyphase torque converters, Converter coupling.

Module 4

Need for automatic transmission, Principle of operation. Hydraulic control system for automatic transmission. Chevrolet “Turbo glide” Transmission, Continuously Variable Transmission (CVT) – Types – Operations, Direct Shift Gear Box- construction

Module 5

Hydrostatic drive - Various types of hydrostatic systems, Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, Construction and Working of typical Janny hydrostatic drive.

Electric drive - Principle of operation of Early and Modified Ward Leonard Control system, Advantages & limitations.

Text Books

1. Newton and Steeds, The Motor Vehicle, Iliffe & Sons Ltd.
2. N. K. Giri, Automobile Mechanics, Khanna publishers

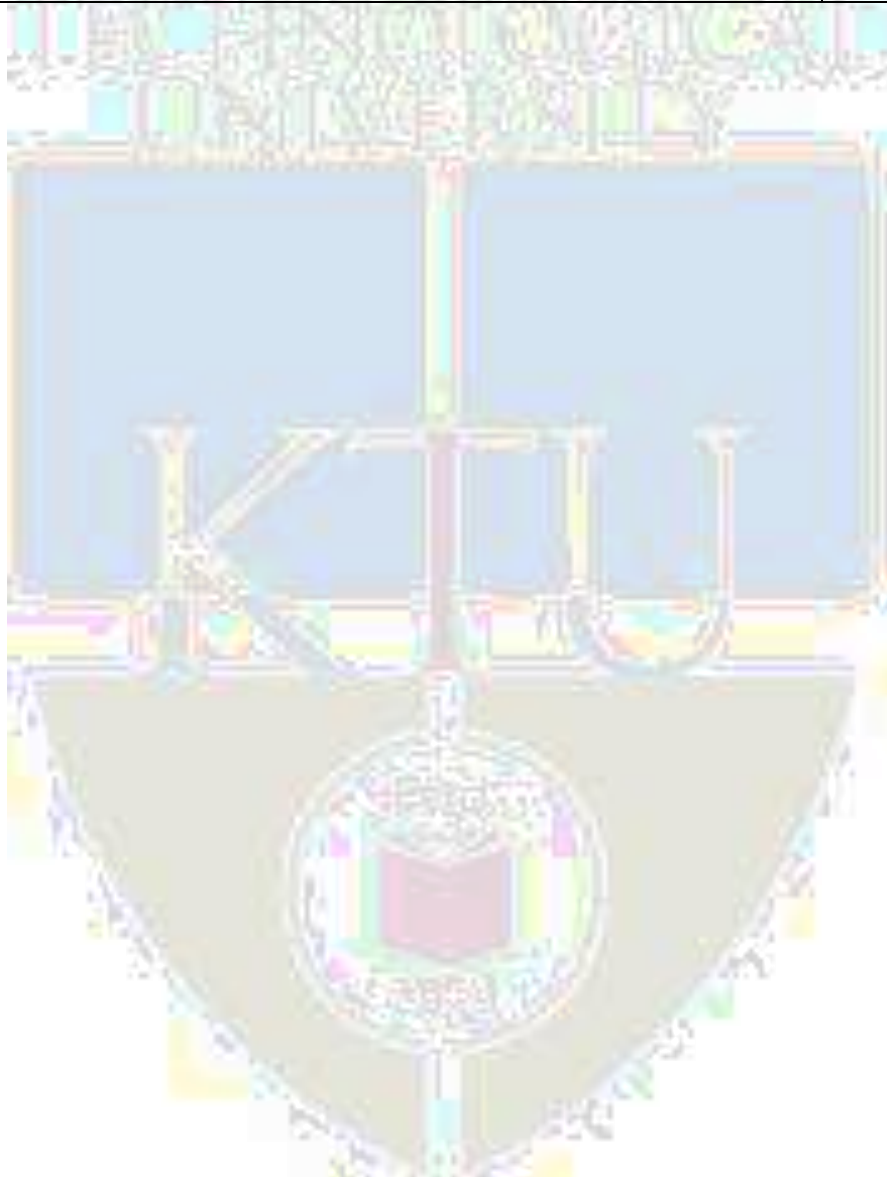
Reference Books

1. Torque converters or Transmissions, Heldt, P.M.
2. Heinz Heisler, Advanced vehicle technology, Society of Automotive Engineers Inc, 2002

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Module 1 (9 hours)	
1.1	Introduction: Performance of automobile. Resistances offered to the motion of a vehicle such as resistance to motion,	3
1.2	Tractive effort, engine speed, engine power and acceleration.	2
1.3	Requirement of transmission system.	1
1.4	Clutches: Different types of clutches - principle, construction and torque capacity, simple problems on clutches.	3
2	Module 2 (9 hours)	
2.1	Different types of gearboxes such as Sliding mesh gearbox, Constant mesh gearbox and Synchromesh gearbox	3
2.2	Determination of gear ratios for vehicles. Simple problems.	3
2.3	Gear shifting mechanisms in each type of gearboxes	3
3	Module 3 (9 hours)	
3.1	Simple epicyclic gear train, Construction and operation of Ford – T-model gearbox, Wilson Gear box and electromagnetic transmission.	3
3.2	Principle of operation, Constructional details, Performance characteristics – Fluid coupling and Torque converter.	3
3.3	Constructional details of Multistage torque converters, Polyphase torque converters, Converter coupling.	3
4	Module 4 (9 hours)	
4.1	Need for automatic transmission, Principle of operation.	2
4.2	Hydraulic control system for automatic transmission.	2
4.2	Chevrolet “Turboglide” Transmission.	2
4.2	Continuously Variable Transmission (CVT) – Types – Operations, Direct Shift Gear Box- construction	3

5	Module 5 (9hours)	
5.1	Hydrostatic drive - Various types of hydrostatic systems, Principles of Hydrostatic drive system	3
5.2	Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, Construction and Working of typical Janny hydrostatic drive.	3
5.3	Electric drive - Principle of operation of Early and Modified Ward Leonard Control system, Advantages & limitations.	3



CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MCN202	CONSTITUTION OF INDIA		2	0	0	NIL

Preamble:

The study of their own country constitution and studying the importance environment as well as understanding their own human rights help the students to concentrate on their day to day discipline. It also gives the knowledge and strength to face the society and people.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the background of the present constitution of India and features.
CO 2	Utilize the fundamental rights and duties.
CO 3	Understand the working of the union executive, parliament and judiciary.
CO 4	Understand the working of the state executive, legislature and judiciary.
CO 5	Utilize the special provisions and statutory institutions.
CO 6	Show national and patriotic spirit as responsible citizens of the country

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	2	2		2		
CO 2						3	3	3		3		
CO 3						3	2	3		3		
CO 4						3	2	3		3		
CO 5						3	2	3		3		
CO 6						3	3	3		2		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			

Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

- 1 Discuss the historical background of the Indian constitution.
- 2 Explain the salient features of the Indian constitution.
- 3 Discuss the importance of preamble in the implementation of constitution.

Course Outcome 2 (CO2)

- 1 What are fundamental rights ? Examine each of them.
- 2 Examine the scope of freedom of speech and expression underlying the constitution.
- 3 The thumb impression of an accused is taken by the police against his will. He contends that this is a violation of his rights under Art 20(3) of the constitution. Decide.

Course Outcome 3(CO3):

- 1 Explain the powers of the President to suspend the fundamental rights during emergency.

- 2 Explain the salient features of appeal by special leave.
3. List the constitutional powers of President.

Course Outcome 4 (CO4):

- 1 Discuss the constitutional powers of Governor.
- 2 Examine the writ jurisdiction of High court.
- 3 Discuss the qualification and disqualification of membership of state legislature.

Course Outcome 5 (CO5):

- 1 Discuss the duties and powers of comptroller of auditor general.
- 2 Discuss the proclamation of emergency.
- 3 A state levies tax on motor vehicles used in the state, for the purpose of maintaining roads in the state. X challenges the levy of the tax on the ground that it violates the freedom of interstate commerce guaranteed under Art 301. Decide.

Course Outcome 6 (CO6):

- 1 Explain the advantages of citizenship.
- 2 List the important principles contained in the directive principles of state policy.
- 3 Discuss the various aspects contained in the preamble of the constitution

Model Question paper

PART A

(Answer all questions. Each question carries 3 marks)

- 1 Define and explain the term constitution.
- 2 Explain the need and importance of Preamble.
- 3 What is directive principle of state policy?
- 4 Define the State.
- 5 List the functions of Attorney general of India.

- 6 Explain the review power of Supreme court.
- 7 List the qualifications of Governor.
- 8 Explain the term and removal of Judges in High court.
- 9 Explain the powers of public service commission.
- 10 List three types of emergency under Indian constitution.

(10X3=30marks)

PART B

(Answer on question from each module. Each question carries 14 marks)

Module 1

- 11 Discuss the various methods of acquiring Indian citizenship.
- 12 Examine the salient features of the Indian constitution.

Module 2

- 13 A high court passes a judgement against X. X desires to file a writ petition in the supreme court under Art32, on the ground that the judgement violates his fundamental rights. Advise him whether he can do so.
- 14 What is meant by directive principles of State policy? List the directives.

Module3

- 15 Describe the procedure of election and removal of the President of India.
- 16 Supreme court may in its discretion grant special leave to appeal. Examine the situation.

Module 4

- 17 Discuss the powers of Governor.
- 18 X filed a writ petition under Art 226 which was dismissed. Subsequently, he filed a writ petition under Art 32 of the constitution, seeking the same remedy. The Government argued that the writ petition should be dismissed, on the ground of res judicata. Decide.

Module 5

19 Examine the scope of the financial relations between the union and the states.

20 Discuss the effects of proclamation of emergency.

(14X5=70marks)

Syllabus

Module 1 Definition, historical back ground, features, preamble, territory, citizenship.

Module 2 State, fundamental rights, directive principles, duties.

Module 3 The machinery of the union government.

Module 4 Government machinery in the states

Module 5 The federal system, Statutory Institutions, miscellaneous provisions.

Text Books

1 D D Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi, 24e, 2019

2 PM Bhakshi, The constitution of India, Universal Law, 14e, 2017

Reference Books

1 Ministry of law and justice, The constitution of India, Govt of India, New Delhi, 2019.

2 JN Pandey, The constitutional law of India, Central Law agency, Allahabad, 51e, 2019

3 MV Pylee, India's Constitution, S Chand and company, New Delhi, 16e, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Module 1	
1.1	Definition of constitution, historical back ground, salient features of the constitution.	1
1.2	Preamble of the constitution, union and its territory.	1
1.3	Meaning of citizenship, types, termination of citizenship.	2
2	Module 2	
2.1	Definition of state, fundamental rights, general nature, classification, right to equality ,right to freedom , right against exploitation	2

HUMANITIES

2.2	Right to freedom of religion, cultural and educational rights, right to constitutional remedies. Protection in respect of conviction for offences.	2
2.3	Directive principles of state policy, classification of directives, fundamental duties.	2
3	Module 3	
3.1	The Union executive, the President, the vice President, the council of ministers, the Prime minister, Attorney-General, functions.	2
3.2	The parliament, composition, Rajya sabha, Lok sabha, qualification and disqualification of membership, functions of parliament.	2
3.3	Union judiciary, the supreme court, jurisdiction, appeal by special leave.	1
4	Module 4	
4.1	The State executive, the Governor, the council of ministers, the Chief minister, advocate general, union Territories.	2
4.2	The State Legislature, composition, qualification and disqualification of membership, functions.	2
4.3	The state judiciary, the high court, jurisdiction, writs jurisdiction.	1
5	Module 5	
5.1	Relations between the Union and the States, legislative relation, administrative relation, financial Relations, Inter State council, finance commission.	1
5.2	Emergency provision, freedom of trade commerce and inter course, comptroller and auditor general of India, public Services, public service commission, administrative Tribunals.	2
5.3	Official language, elections, special provisions relating to certain classes, amendment of the Constitution.	2

AUTOMOBILE ENGINEERING

CODE MEL202	COURSE NAME FM & HM LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble:

This lab is mainly focussed to develop a platform where the students can enhance their engineering knowledge in the fluid mechanics domain by applying their theoretical knowledge acquired.

Prerequisite: MET203 Mechanics of Fluids

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Determine the coefficient of discharge of flow measuring devices (notches, orifice meter and Venturi meter)
CO 2	Calibrate flow measuring devices (notches, orifice meter and Venturi meter)
CO 3	Evaluate the losses in pipes
CO 4	Determine the metacentric height and stability of floating bodies
CO 5	Determine the efficiency and plot the characteristic curves of different types of pumps and turbines

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1						2	3	2		2
CO 2	2	1						2	3	2		2
CO 3	2	1						2	3	2		2
CO 4	2	1						2	3	2		2
CO 5	2	1						2	3	2		2

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	: 15 marks
Continuous Assessment	: 30 marks
Internal Test (Immediately before the second series test)	: 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting)	: 25 Marks
(d) Viva voce	: 20 marks
(e) Record	: 5 Marks

General instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

A minimum of 10 experiments are to be performed.

SYLLABUS

LIST OF EXPERIMENTS

1. Determination of coefficient of discharge and calibration of Notches.
2. Determination of coefficient of discharge and calibration of Orifice meter.
3. Determination of coefficient of discharge and calibration of Venturi meter.
4. Determination of hydraulic coefficients of orifices.
5. Determination of Chezy's constant and Darcy's coefficient on pipe friction apparatus.
6. Determine the minor losses in pipe.
7. Experiments on hydraulic ram.
8. Reynolds experiment.
9. Bernoulli's experiment.
10. Determination of metacentric height and radius of gyration of floating bodies.
11. Performance test on positive displacement pumps.

12. Performance test on centrifugal pumps, determination of operating point and efficiency.
13. Performance test on gear pump.
14. Performance test on Impulse turbines.
15. Performance test on reaction turbines (Francis and Kaplan Turbines).
16. Speed variation test on Impulse turbine.
17. Determination of best guide vane opening for Reaction turbine.
18. Impact of jet.

Reference Books

1. Yunus A. Cengel, John M. Cimbala; Fluid Mechanics- Fundamentals and Applications (in SI Units); McGraw Hill, 2010.
2. Bansal R.K, Fluid Mechanics and Hydraulic Machines (SI Units); Laxmi Publications, 2011.
3. Modi P.N and Seth S.M, "Hydraulics and Fluid Mechanics Including Hydraulic Machines" Standard Book House, New Delhi, 20th Edition, 2015
4. Graebel. W. P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
5. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, "Fluid Mechanics and Machinery", John Wiley and sons, 2015.
6. J. Frabzini, 'Fluid Mechanics with Engineering Applications', McGraw Hill, 1997.

AUTOMOBILE ENGINEERING

CODE AUL202	COURSE NAME AUTOMOBILE LAB II	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble:

This lab is mainly focussed to develop a platform where the students can enhance their engineering knowledge in maintenance of various automobile components by using sophisticated tools and equipments.

Prerequisite: AUL201 - Automobile Lab I

Course Outcomes:

After the completion of the course the student will be able to

CO 1	To study about special purpose tools and their uses.
CO 2	To study about special purpose machines used in automotive service centers
CO 3	To familiarize with various systems and components of an automobile.
CO 4	To familiarize with power transmission and scheduled maintenance

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1						2	3	2		2
CO 2	2	1						2	3	2		2
CO 3	2	1						2	3	2		2
CO 4	2	1						2	3	2		2
CO 5	2	1						2	3	2		2

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work	:	15 Marks
(b) Implementing the work/Conducting the experiment	:	10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting)	:	25 Marks
(d) Viva voce	:	20 marks
(e) Record	:	5 Marks

General instructions:

Practical examination to be conducted after the second series test covering minimum 12 exercises/experiments given below. End Semester Examination Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

SYLLABUS

LIST OF EXPERIMENTS

Study

1. Study and practice on air compressor
2. Study and practice on two post lift

List of Exercises/Experiments

1. Wheel balancing: Balancing of wheels by computerized wheel balancing machine.
2. Wheel alignment: Checking the camber, caster, king pin inclination, toe in and toe out with computerized wheel alignment machine.
3. Tyre codes , Tyre removing, inspection, check for cuts, bulges and excessive tread wear, resetting using pneumatic tyre changer
4. Understanding and differentiating tyres based on various parameters used in 2 wheelers, LMV, HMV and Off Road vehicles
5. Cylinder reconditioning: Checking the cylinder bore, setting the tool, re-boring operation using vertical cylinder reboring machine.
6. Cylinder liners setting of engine using hydraulic press

AUTOMOBILE ENGINEERING

7. Line boring: measure bore , setting bore , Setting the tool, line boring using horizontal line boring machine
8. Engine Valve reconditioning: Valve grinding by using valve re-facing machine, valve seat grinding, lapping and valve angle cutting.
9. Checking the emission of gasoline engine with exhaust gas analyzer
10. Checking the emission of diesel engine with diesel smoke meter.
11. Cleaning and testing spark plug , checking C. B. Point gap
12. Rectifying the troubles in ignition system, ignition timing setting.
13. Schedule Vehicle maintenance : oil level check , Oil top up, Oil change , Fuel filter replacement of 4 wheeler, Air filter checkup , Radiator coolant top up, Air Conditioning filter checkup
14. Understand the elements of power transmission system employed in automobiles
15. MPFI engine test rig

Reference Books

1. Automobile Engineering , Vol 1 , Dr Kripal Singh , Standard Publishers distributors
2. Automobile Engineering , Vol 2 , Dr Kripal Singh , Standard Publishers distributors
3. Automobile Engineering Practical, N Malhotra , Asian Publishers
4. Vehicle service manuals of reputed manufacturers.
5. Automotive Mechanics , William H Crouse Donald L Anglin, Tata Mcgraw Hill Publishing

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER V



AUTOMOBILE ENGINEERING

AUTOMOBILE ENGINEERING SEMESTER 5

AUT301	THEORY OF MACHINES	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: The aim of this subject is to provide students with a general understanding of the kinematics and dynamics various mechanisms.

- ✓ Understanding of different types of mechanisms.
- ✓ Understanding of various types of clutches and brakes.
- ✓ Analyse cam-follower motions and gear train configurations.
- ✓ To impart basic concepts of Turning moment diagram and flywheels.
- ✓ To understand the balancing methods for rotating and reciprocating masses.
- ✓ To understand theory of vibration of different vibration systems.

Prerequisite: EST 100 Engineering Mechanics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the kinematics of planar mechanisms and describe the principles of different types of brakes and clutches.
CO 2	Define cam terminologies and apply kinematic principles to sketch a cam profile for a specified follower motion.
CO 3	Illustrate different types of gears and solve terminologies of gears and velocity of gears in a gear train.
CO 4	Understanding on the Turning Moment Diagrams and use of the Flywheels in various machines and Demonstrate the concepts of static and dynamic balancing to rotating and reciprocating machine parts and analyse them for required balance.
CO 5	Build the basics of single degree and multi degree of freedom vibrations and their measurements.

Mapping of course outcomes with program outcomes

[illegible]

AUTOMOBILE ENGINEERING

4												
CO 5	3	2	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer anyone. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the inversion of a for bar chain.
2. Compare Davis and Ackerman's steering gear mechanisms.
3. Classify Kinematic pairs with examples.
4. Differentiate between self-locking and self-energising brakes.

5. What is a clutch? State its different types.

Course Outcome 2(CO2):

1. Explain the classification of cam followers.
2. Derive the expression for maximum velocity and acceleration for a follower moving with simple harmonic motion.

Course Outcome 3 (CO3):

1. Explain interference in involute gears. Explain any method to avoid interference.
2. Derive equation for path of contact and arc of contact of mating gears.
3. List various types of gear trains and their applications.

Course Outcome 4 (CO4):

1. Define coefficient of fluctuation of energy and coefficient fluctuation of speed
2. What is the main function of a flywheel?
3. Draw the turning moment diagram for a 4-stroke engine
4. Write a short note on primary and secondary balancing.
5. Explain hammer blow and swaying couple.
6. Derive the magnitude of unbalanced primary and secondary forces in a V-engine.

Course Outcome 5 (CO5):

1. What are the basic elements of a vibrational system? What is meant by degrees of freedom of a vibrational system?
2. What is logarithmic decrement? Derive the expression for the same.
3. What is meant by magnification factor in case of forced vibrations? On what factors does it depend?

Model Question paper

QP CODE:

PAGES: 4

Reg. No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT301

Course Name: THEORY OF MACHINES

Max. Marks: 100

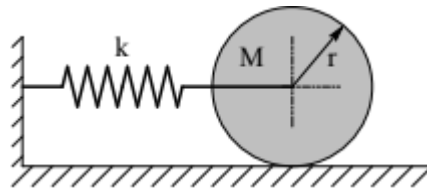
Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

- 1) What is meant by inversion? Name the inversions of a slider crank chain.
- 2) Define the following terms.
 - a) Mechanism
 - b) Kinematic Pair
 - c) Kinematic Chain
 - d) Kinematic link
 - e) Machine.
- 3) Explain the working of a centrifugal clutch.
- 4) Derive the expression for maximum velocity and acceleration of a follower moving with cycloidal motion.
- 5) State and prove law of gearing.
- 6) Explain different types of gear trains.
- 7) Draw the turning moment diagram for a four-stroke engine.
- 8) Differentiate static balancing and dynamic balancing.
- 9) Find the frequency of oscillations of the system shown in figure.



- 10) What is meant by logarithmic decrement? Derive the expression for the same.

PART B

Answer any one full question from each module.

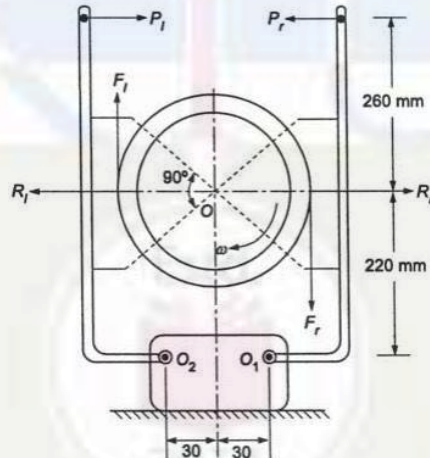
Each question carries 14 Marks

Module 1

- 11) With the help of neat sketches explain the classifications of kinematic pairs.

Or

- 12) A double-shoe (shown in figure) brake can absorb a torque of 1500 Nm. The diameter of the brake drum is 300 mm and the angle of contact for each shoe is 90° . The coefficient of friction between the brake drum and the lining is 0.35. Find (a) the spring force necessary to set the brake and (b) width of the brake shoes. The bearing pressure on the lining material is not to exceed 0.25 MPa.



Module 2

- 13) A single-plate clutch, with both sides effective, has inner and outer diameters of friction surface 250 mm and 350 mm, respectively. The maximum intensity of pressure is not to exceed 0.15 MPa. The coefficient of friction is 0.3. Determine the power transmitted by the clutch at a speed of 2400 rpm for
- Uniform Wear
 - Uniform Pressure.

Or

AUTOMOBILE ENGINEERING

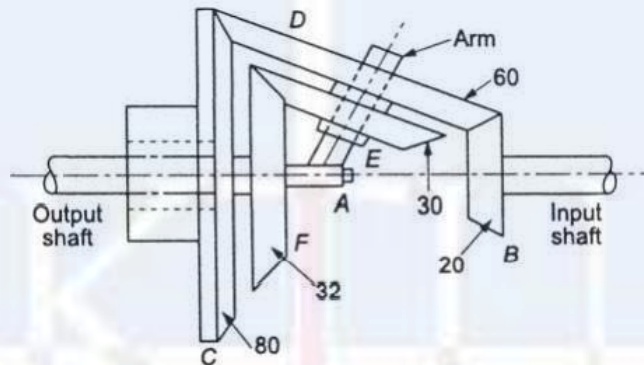
- 14) Design a cam to raise a valve with simple harmonic motion through 50 mm in $\frac{1}{3}$ of a revolution, keep it fully raised through $\frac{1}{12}$ revolution and to lower it with harmonic motion in $\frac{1}{6}$ revolution. The valve remains closed during the rest of the revolution. The diameter of the roller is 20 mm and the minimum radius of the cam is 25 mm. The diameter of the camshaft is 25 mm. The axis of the valve rod passes through the axis of the camshaft. If the camshaft rotates at uniform speed of 100 r.p.m.; find the maximum velocity and acceleration of a valve during raising and lowering.

Module 3

- 15) Derive the expression for Length of path of contact, length of arc of contact and contact ratio.

Or

- 16) In a gear train, as shown in Fig, gear B is connected to the input shaft. The arm A carrying the compound wheels D and E, turns freely on the output shaft. If the input speed is 1200 rpm counter-clockwise, when seen from the right, determine the speed of the output shaft under the following conditions: (a) when the gear C is fixed and (b) when gear C rotates at 10 rpm counter clockwise.



Module 4

- 17) A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45° , B to C 70° and C to D 120° . The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions.

Or

- 18) The three cranks of a three-cylinder locomotive are all on the same axle and are set at 120° . The pitch of the cylinders is 1 metre, and the stroke of each piston is 0.6 m. The reciprocating masses are 300 kg for inside cylinder and 260 kg for each outside cylinder and the planes of rotation of the balance masses are 0.8 m from the inside crank. If 40% of the reciprocating parts are to be balanced, find: 1. the magnitude and the position of the balancing masses required at a radius of 0.6 m; and 2. the hammer blow per wheel when the axle makes 6 r.p.s.

Module 5

- 19) Derive the response of damped free vibration system for under damping, overdamping, and critical damping conditions.

Or

- 20) A body having a mass of 15kg is suspended from a spring which deflects 12mm under the weight of the mass. Determine the frequency of free vibrations. What is the viscous damping force needed to make the motion aperiodic at a speed of 1mm/s? If, when damped to this extent, a disturbing force having magnitude value of 100N and vibrating at 6Hz is made to act on the body, determine the amplitude of the ultimate motion.

SYLLABUS

Module 1

Planar Mechanisms-Terminology and definitions. Kinematic pairs, kinematic chains, and degrees of freedom of mechanisms. Kinematic Inversion of 4 bar and slider crank chains. Condition for correct steering. Davis Steering gear and Ackerman Steering gear (No numerical questions).

Brakes-Shoe brakes, Band Brakes, and Internal expanding brakes.

Module 2

Clutches-Single plate clutch, multiplate clutch, cone clutch, and centrifugal clutch.

Cams and followers- Cams - classification of cam and followers - displacement diagrams, velocity, and acceleration analysis of SHM, uniform velocity, uniform acceleration, cycloidal motion. Construction of cam profiles.

Module 3

Gears and Gear Trains- Classification of gears. Terminology and definitions of spur gears. Law of gearing, length of path of contact, arc of contact and contact ratio. Interference and minimum number of teeth to avoid interference. Simple and compound gear trains, planetary gear trains, differential, solution of planetary gear train problems.

Module 4

Flywheels-Turning moment diagrams, fluctuation of energy, flywheel, size of flywheel (No numerical problems).

Balancing of Rotating masses-static and dynamic balancing - balancing of masses rotating in several planes.

Balancing of Reciprocating masses-Balancing of reciprocating masses - balancing of multi-cylinder in line engines – V-engines.

Module 5

Mechanical Vibrations-Free vibrations of single degree freedom systems, energy Method. Undamped and damped free vibrations, viscous damping, critical damping, logarithmic decrement, harmonically excited vibrations. Response of an undamped and damped system, beat phenomenon, transmissibility.

AUTOMOBILE ENGINEERING

Introduction to multi-degree freedom systems (No numerical Problems). vibration measurement – accelerometer, seismometer.

Text Books

1	Theory of Machines	S S Rattan	Tata McGraw-Hill Publishing Co
2	Theory of Machines: Kinematics and Dynamics	Sadhu Singh	Pearson
3	Theory of Machines	V P Singh	Dhanpat Rai & Co
4	Mechanical Vibrations	V P Singh	Dhanpat Rai & Co

Reference Books

1	Theory of Machines and Mechanism	J E Shigley J J Unicker	Oxford University Press
2	Kinematics and Dynamics of Machinery	Robert L Norton	Tata McGraw-Hill Publishing Co
3	Theory of Machines	Thomas Bevan	Pearson
4	Theory of vibration with applications	W T Thomson	Pearson
5	Dynamics of Machinery	A R Holowenko	John Wiley & Sons

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Module 1 (9 hours)	
1.1	Mechanism, machine, and structure. Kinematic pair, Kinematic Chain and Degrees of freedom of mechanisms.	2
1.2	Kinematic Inversions of 4 bar chain and slider crank chain. Quick return mechanisms.	3
1.3	Condition for correct steering, Davis and Ackerman Steering Gear Mechanisms	1
1.4	Shoe brakes, Band Brakes, and Internal expanding brakes.	3
2	Module 2 (9 hours)	
2.1	Single plate clutch, multiplate clutch, cone clutch, and centrifugal clutch.	4
2.2	Cams - classification of cam and followers - displacement diagrams,	5

AUTOMOBILE ENGINEERING

	velocity, and acceleration analysis of SHM, uniform velocity, uniform acceleration, cycloidal motion. Construction of cam profiles.	
3	Module 3 (9 hours)	
3.1	Classification of gears. Terminology and definitions of spur gears. Law of gearing.	1
3.2	length of path of contact, arc of contact and contact ratio. Interference and minimum number of teeth to avoid interference.	4
3.3	Simple and compound gear trains, planetary gear trains, differential, solution of planetary gear train problems	4
4	Module 4 (9hours)	
4.1	Turning moment diagrams.	1
4.2	Fluctuation of energy, flywheel and applications, size of flywheel	1
4.3	Balancing of rotating masses, static and dynamic balancing, balancing of rotating masses in several planes.	3
4.4	Balancing of reciprocating masses, balancing of Locomotives, effect of partial balancing in Locomotives, primary and secondary balancing and balancing of inline engines.	3
4.5	Balancing of V Engine.	1
5	Module 5 (9 hours)	
5.1	Vibrations- Definitions, classifications basic elements of vibrational system.	1
5.2	Undamped free vibrations, energy method.	1
5.3	Damped free vibration, equation of motion, response of damped free vibrations, over damping, under damping and critical damping. Logarithmic decrement.	3
5.4	Harmonically excited vibrations, beat phenomenon, magnification factor, transmissibility.	2
5.5	Multi degree of freedom systems, Dunkerley's Method	1
5.6	Vibration measurement-Accelerometer, Seismometer.	1

AUTOMOBILE ENGINEERING

AUT303	MANUFACTURING PROCESS	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: The aim of this subject is to offer the students a general understanding of various manufacturing process.

- ✓ To understand the basic concept of foundry and casting, metal forming and welding.
- ✓ To know different defects formed in the manufacturing process.
- ✓ To select the proper manufacturing process for the given applications.
- ✓ To select the non-traditional machining process for the given applications.
- ✓ To understand the basics of advanced manufacturing technology.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the basic concept of foundry and casting
CO 2	Explain the different types of Metal joining process
CO 3	Discuss the different metal forming process
CO 4	Explain the non-conventional machining process
CO 5	Explain the advanced manufacturing technology

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	1	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	1	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
Analyse			

Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Explain the basic concept of foundry and casting
2. Explain Applications of Casting.

Course Outcome 2 (CO2)

1. Explain the metal Joining processes.
2. Differentiate between the soldering & brazing

Course Outcome 3(CO3):

1. Discuss the metal forming process.
2. Explain the Forging & Rolling process
3. Explain the Extrusion process.

Course Outcome 4 (CO4):

1. Explain the non-conventional machining process
2. Explain the Laser Beam, Plasma Arc Machining Electro Chemical Machining, Ultrasonic Machining,

3. Explain Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining

Course Outcome 5 (CO5):

1. Discuss the Advanced Manufacturing Techniques.
2. Explain the Micro machining
3. Explain the Rapid prototyping & Nano technology

Model Question paper

QP CODE:

3

PAGES:

Reg. No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT303

Course Name: MANUFACTURING PROCESS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. Discuss shell mould casting, mention its advantages and disadvantage
2. Explain the basic steps involved in casting process.
3. What is the principle of plasma? Explain plasma arc welding
4. You are assigned to join 'Rails' by Indian railways. Explain the suitable welding process with neat sketch.
5. Explain deep drawing operation with neat sketch and mention the importance of die clearance
6. What do you understand by the term 'forging'? Explain the following (i) Open die forging (ii) Closed-die forging
7. Explain the principle and working of Electro Chemical Grinding (ECG) process with suitable diagram.
8. Explain Abrasive Jet Machining (AJM) process and its process parameters
9. What is rapid prototyping? Explain in detail (i) Selective Laser Sintering (SLS) (ii) Stereolithography (SLA)

10. What is nano Technology? Give details about its applications in various fields

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11. Explain the construction and working principle of cupola furnace.

Or

12. Explain the vacuum casting process with figure

Module 2

13. Explain Tungsten Inert Gas (TIG) welding in detail.

Or

- 14.** a. Compare soldering and brazing processes
b. List the advantages and disadvantages

Module 3

- 15.** a. What are the classifications of extrusion process?
b. Explain any two extrusion types in detail.

Or

16. Discuss the principle and mechanism of rolling with suitable figure.

Module 4

- 17.** a. Explain with a neat sketch the principle and working of Ultrasonic Machining (USM) process.
b. List its advantages, disadvantages and applications.

Or

18. What is the principle of Electron Beam Machining (EBM)? Explain the process in details.

Module 5

- 19.** a. What is microfabrication technology?
b. Explain (i) Micro cutting (ii) Micro finishing

Or

- 20.** a. State the main factors that affect the selection of a manufacturing process.
b. Explain (i) Process Information Maps (ii) Elimination and Ranking Strategy

SYLLABUS

Module 1

CASTING: Steps involved in making a casting – Advantage of casting and its applications. Patterns and Pattern making – Types of patterns – Materials used for patterns, core and core making, casting design considerations. Casting processes - Sand, CO₂ moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting. Methods of Melting: Crucible melting and cupola operation, Defects in casting.

Module 2

WELDING: Classification of welding processes. Principles of Oxy-acetylene gas welding, A.C Metal-arc welding, Resistance welding, Submerged arc welding, Tungsten inert gas welding, Metal inert gas welding, plasma arc welding, Thermit welding, Electron beam welding, Laser beam welding, defects in welding, soldering and brazing.

Module 3

FORMING AND SHAPING OF PLASTICS: Blanking and piercing – Bending and forming Rolling, Theory of Rolling, Types of Rolling mills. Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning Basic extrusion processes and its characteristics. Forging processes - Principles of forging, tools and dies - Types of forging – Open, closed, drop forging, roll forging.

Module 4

Non-Traditional Machining Processes: Need for non-traditional machining, Principle, equipment & operation of Laser Beam, Plasma Arc Machining, Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining

Module 5

Advanced manufacturing techniques –Material addition process:3D Printing- stereo-lithography, selective laser sintering, fused deposition modelling, laminated object manufacturing, laser engineered net-shaping, LIGA process. Sustainable and green manufacturing Application of Nano Technology. Manufacturing process capabilities – process selection factors process information maps – ranking strategy

Text Books

1	Manufacturing Engineering and Technology,	Kalapakjian and Schmid	Pearson, 7e, 2013
2	Introduction to Manufacturing Processes	Schey A John	Tata McGraw Hill, Noida, 2012
3	Elements of Workshop Technology Vol:1	S.K HajraChoudhur	Media Promoters & Publishers Pvt. Ltd.

AUTOMOBILE ENGINEERING

		y,A.KHajra Choudhury Nirjhar Roy	
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Reference Books

4	Principles of Metal Casting	Heine, Loper and Rosenthal	Tata McGraw Hill Publishing Co, Ltd; New Delhi, 2011.
5	Foundry Engineering	Banga T.R; and Agrawal R.L	Khanna Publishers, New Delhi, 2007
6	Manufacturing Technology (materials, processes and equipments)	Helmi A Youssef, Hassan A El-Hofy and Mahmoud H Ahmed,	CRC Press, 2017

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	CASTING Module 1 (9 hours)	
1.1	Steps involved in making a casting Advantage of casting and its applications	1
1.2	Patterns and Pattern making – Types of patterns – Materials used for patterns	2
1.3	Core and core making, casting design considerations.	2
1.4	Casting processes - Sand, CO2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting	2
1.5	Methods of Melting: Crucible melting and cupola operation Defects in casting.	2
2	WELDING: Module 2 (9 hours)	
2.1	Classification of welding processes	1
2.2	Principles of Oxy-acetylene gas welding.	1
2.3	A.C Metal-arc welding, Resistance welding, Submerged arc welding	2
2.4	Tungsten inert gas welding, Metal inert gas welding, plasma arc welding, Thermit welding	2
2.5	Electron beam welding, Laser beam welding, defects in welding,	2

AUTOMOBILE ENGINEERING

2.6	Soldering and brazing.	1
3	FORMING AND SHAPING OF PLASTICS: Module 3 (9 hours)	
3.1	Blanking and piercing – Bending and forming – Rolling, Theory of Rolling, Types of Rolling Mills.	2
3.2	Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning – Types of presses and press tool	2
3.3	Basic extrusion processes and its characteristics	2
3.4	Forging processes - Principles of forging, tools and dies - Types of forging – Open, closed, drop forging, roll forging.	2
3.5	Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding.	1
4	Non-Traditional Machining Processes : Module-4 (9 hours)	
4.1	Non-Traditional Machining Processes: Need for non-traditional machining,	3
4.2	Principle, equipment & operation of Laser Beam, Plasma Arc Machining,	3
4.3	Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining	3
5	Advanced manufacturing techniques : Module-5 (10 hours)	
5.1	Advanced manufacturing techniques –Material addition process: 3D Printing, stereo-lithography, selective laser sintering,	3
5.2	Fused deposition modelling, laminated object manufacturing, laser engineered net-shaping, LIGA process.	3
5.3	Sustainable and green manufacturing. application of nano technology	2
5.4	Manufacturing process capabilities – process selection factors process information maps – ranking strategy	2

AUTOMOBILE ENGINEERING

AUT 305	HYBRID AND FUEL CELL VEHICLES	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: The aim of this subject is to offer the students a general understanding of hybrid (internal combustion and electric motor) propulsion system and an overview of fuel cell vehicles.

- ✓ Explain about hybrid electric vehicles.
- ✓ Describe the construction and working of hybrid electric drive trains
- ✓ Explain the importance of energy storage in hybrid vehicles.
- ✓ Discuss the important steps in sizing the drive system.
- ✓ Explain the different types of fuel cells.

Prerequisite:

Basic Electrical Engineering

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the construction and working of various hybrid electric topologies.
CO 2	Discuss the construction and working of various electric motors.
CO 3	Explain the various energy storage systems available.
CO 4	Explain the procedure to match electric motor and ic engine.
CO 5	Understand the construction and working of various types of fuel cells.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	1	-	-	-	-	-	-	-	-	-
CO 2	3	-	1	-	-	-	-	-	-	-	-	-
CO 3	3	-	1	-	-	-	-	-	-	-	-	-
CO 4	3	2	1	-	-	-	-	-	-	-	-	-
CO 5	3	-	1	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			

AUTOMOBILE ENGINEERING

Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are the various components of a hybrid vehicle?
2. What are various drive train topologies used in electric vehicles?

Course Outcome 2 (CO2)

1. Explain the construction and working of PMDC motor?
2. Explain BLDC motor drive configuration?

Course Outcome 3(CO3):

1. What is the importance of energy storage in a hybrid electric vehicle?
2. How does Flywheel based energy storage work?

Course Outcome 4 (CO4):

1. How matching of IC engine is done with electric machine in a hybrid vehicle?
2. What are the factors affecting selection and sizing of storage systems in hybrid vehicles?

Course Outcome 5 (CO5):

1. Explain the working of alkaline fuel cell?
2. Explain how the construction and working of solid oxide fuel cell?

Model Question paper

QP CODE:

PAGES:

2

Reg. No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT305

Course Name: HYBRID AND FUEL CELL VEHICLES

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. How traction is achieved in Hybrid Electric vehicles?
2. What are the advantages and disadvantages of hybrid electric vehicle?
3. What is the construction of PMDC motors?
4. What is the construction of BLDC motors?
5. What are the requirements for energy storage systems in HEV and pure electric vehicle?
6. Describe the analysis of a fuel cell-based energy storage device.
7. How is power electronics sized for a hybrid electric vehicle?
8. How is the motor sized for a hybrid electric vehicle?
9. Explain the operating principle of a fuel cell.
10. List the different types of fuel cell systems available for HEVs.

PART B

Answer any one full question from each module.

Each question carries 14 marks

Module 1

AUTOMOBILE ENGINEERING

11. Explain the power flow and control modes of series hybrid electric vehicles with the help of suitable sketches. (14)

Or

12. What are various drive train topologies used in electric hybrid vehicles? Explain (14)

Module 2

13. List out and explain various electric components used in hybrid vehicles. (14)

Or

14. With the help of a neat sketch, explain the construction, working and application of Brushless DC motor. (14)

Module 3

15. Explain fuel cell-based energy storage and its analysis? (14)

Or

16. Write short note on ultra-capacitor energy storage system and super conducting magnetic energy storage. (14)

Module 4

17. How the sizing of propulsion motor and other drive system components done in hybrid vehicles? (14)

Or

18. Design a hybrid electric vehicle including the selection of batteries and electric motor (EM) with Parallel hybrid as base /core. (14)

Module 5

19. Explain the construction and working of the following fuel cells:(i) phosphoric acid fuel cell (ii) Proton exchange membrane fuel cell (14)

Or

20. Explain the construction and working of Molten Carbonate fuel cell (MCFC) with the help of a suitable sketch (14)

SYLLABUS

Module 1

Introduction to hybrid electric vehicles: components, advantages and disadvantages, application, social and environmental impacts. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies (Series, Parallel, Series – Parallel), power flow control in hybrid drive-train topologies.

Module 2

Electric Machines and their controllers: ‘Brushed’ DC Electric Motor - DC regulation and voltage conversion; Brushless Electric Motors - brushless DC motor, Switched reluctance motors, Induction motor; Motor cooling, efficiency, size and mass.

Module 3

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices

Short Term Storage Systems: Flywheel Accumulators, Ultra capacitors, Superconducting magnetic energy storage; Hydraulic Accumulators; Hydraulic Pumps/Motors - Pneumatic Hybrid Engine Systems. Energy management strategies used in hybrid and electric vehicles: types, comparison and implementation issues

Module 4

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Module 5

Fuel cell characteristics, fuel cell types: alkaline fuel cell. Proton exchange Membrane; direct methanol fuel cell. Phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, hydrogen storage systems - reformers; Fuel cell vehicles.

Text Books

1. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.

References

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2004.
2. Mike Westbrook, “The Electric Car: Development & Future of Battery-

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Hybrid & Fuel Cell Cars”, British library Cataloguing in Publication Data.

3. John M. Miller, “Propulsion System for Hybrid Vehicle”, The Institution of Engineers, London, UK, 2004.
4. James Larminie, John Lowry – Electric vehicle technology explained – John Wiley

MOOC

NPTEL Course “Introduction to Hybrid and Electric Vehicles”

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Module 1 (9 hours)	
1.1	Introduction to hybrid electric vehicles: components, advantages and disadvantages, application, social and environmental impacts.	3
1.2	Hybrid Electric Drive-trains: Basic concept of hybrid traction	2
1.3	Introduction to various hybrid drive-train topologies	2
1.4	Power flow control in hybrid drive-train topologies	2
2	Module 2 (10 hours)	
2.1	Electric Machines and their controllers: ‘Brushed’ DC Electric Motor - DC regulation and voltage conversion	3
2.2	Brushless Electric Motors - brushless DC motor	2
2.3	Switched reluctance motors; Induction motor;	3
2.4	Motor cooling, efficiency, size and mass	2
3	Module 3 (10 hours)	
3.1	Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles	1
3.2	Battery based energy storage and its analysis	1
3.3	Fuel Cell based energy storage and its analysis	1
3.4	Super Capacitor based energy storage and its analysis	1
3.5	Flywheel based energy storage and its analysis	1
3.6	Hybridization of different energy storage devices	1
3.7	Short Term Storage Systems: Flywheel Accumulators	1

AUTOMOBILE ENGINEERING

3.8	Ultra-capacitors, Superconducting magnetic energy storage	1
3.9	Hydraulic Accumulators; Hydraulic Pumps/Motors; Pneumatic Hybrid Engine Systems	1
3.10	Energy management strategies used in hybrid and electric vehicles: types, comparison and implementation issues	1
4	Module 4 (10 hours)	
4.1	Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE)	3
4.2	Sizing the propulsion motor	3
4.3	Sizing the power electronics	2
4.4	Selecting the energy storage technology, Communications, supporting subsystems	2
5	Module 5 (9 hours)	
5.1	Fuel cell characteristics, fuel cell types: alkaline fuel cell	1
5.2	Proton exchange Membrane	2
5.3	Direct methanol fuel cell	1
5.4	Phosphoric acid fuel cell	1
5.5	Molten carbonate fuel cell,	1
5.6	Solid oxide fuel cell	1
5.7	Hydrogen storage systems - reformers;	1
5.8	Fuel cell vehicles	1

AUTOMOBILE ENGINEERING

AUT 307	MATERIAL SCIENCE AND METALLURGY	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: Understanding of the correlation between the chemical bonds and crystal structure of metallic materials to their mechanical properties.

Recognize the importance of crystal imperfections including dislocations in plastic deformation.

Understand the different phases and heat treatment methods to tailor the properties of iron-carbon alloys.

Examine the mechanisms of materials failure through fatigue and creep.

To determine properties of unknown materials and develop an awareness to apply this knowledge in material design.

Prerequisite: PHT 110 Engineering Physics and CYT 100 Engineering Chemistry

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the basic atomic bonds, crystal structures (BCC, FCC, and HCP), and their relationship with the properties.
CO 2	Recognize the mechanism of solidification of metals and the defects arising from it.
CO 3	Analyse the microstructure of metallic materials using phase diagrams and modify the microstructure and properties using different heat treatments.
CO 4	Define and differentiate engineering materials based on structure and properties for engineering applications.
CO 5	How to quantify mechanical integrity and failure in materials.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3											
CO 2		2										
CO 3		2										
CO 4	2					2	2					
CO 5		2				2						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	25
Understand	20	20	50

AUTOMOBILE ENGINEERING

Apply	15	15	25
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer anyone. Each question can have maximum 2 sub-divisions and carry 14 marks.

COURSE LEVEL ASSESSMENT QUESTIONS

Course Outcome 1 (CO1): Understand the basic atomic bonds, crystal structures (BCC, FCC, and HCP), and their relationship with the properties.

1. Explain the significance of long range and short-range order of atomic arrangement on Mechanical strength.
2. What is the difference between an allotrope and a polymorphism?
3. Sketch the (112) and (111) planes in simple cubic cell.

Course Outcome 2 (CO2): Recognize the mechanism of solidification of metals and the defects arising from it.

1. What is the driving force for crystallisation and grain growth of metallic crystals?
2. Relate the strength of a material with its grain size.
3. Give the influence of dislocations in the mechanical properties of materials.

Course Outcome 3(CO3):Analyse the microstructure of metallic materials using phase diagrams and modify the microstructure and properties using different heat treatments.

1. Why 100 % pure metals are weak in strength?
2. Why annealing is performed on cold worked steel?
3. Describe the heat treatment process employed for gears, engine blocks and shafts used in automobiles.

Course Outcome 4 (CO4): Define and differentiate engineering materials based on structure and properties for engineering applications.

AUTOMOBILE ENGINEERING

1. Give the classification, compositions and applications of high-speed steel? Identify 18:4:1.
2. Explain the fundamental effects of alloying elements in steel on polymorphic transformation temperatures, grain growth, eutectoid point, retardation of the transformation rates, formation and stability of carbides.
3. Explain the importance of non-ferrous alloys in automotive applications.

Course Outcome 5 (CO5): How to quantify mechanical integrity and failure in materials.

1. Draw and explain S-N curves for ferrous and non-ferrous metals. Explain different methods to improve fatigue resistance.
2. Give the failure mechanism of bearings employed in automobiles.
3. Why ductile fracture is preferred over brittle fracture?

MODEL QUESTION PAPER

QP CODE:

PAGES:2

Reg. No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT307

Course Name: MATERIAL SCIENCE AND METALLURGY

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3marks (2 questions from each module)

1. Explain why FCC materials exhibit ductility and BCC and HCP exhibit brittle nature with details of slip systems.
2. Sketch the Miller indices in a simple cubic cell - (1 0 2), [1 1 1], [1 2 1], (1 0 0), [1 0 3]
3. Describe how the solidification cooling rates affects the strength of an engine block produced by casting process?
4. Compare Frenkel and Schottky defects.
5. Annealing results in the formation of softer steel compared to normalising. Why?
6. Explain the difference between hardness and hardenability.
7. Explain the importance of composites in automotive sector.
8. Postulate, why cast irons are brittle?
9. Describe the fatigue failure of components in automobiles.
10. What is the grain size preferred for creep applications? Why?

PART B

Answer any one full question from each module.

Each question carries 14marks

AUTOMOBILE ENGINEERING

Module 1

11. Calculate the APF of BCC, FCC and HCP crystal structures. (14 marks)

OR

12. a. With relevant sketches compare plastic deformation by slip and twinning. (10 marks)

b. Is iron allotropic? Justify. (4 marks)

Module 2

13. a. Differentiate edge and screw dislocations in relevance to Burger's vector. (10 marks)

b. Mathematically relate the yield strength of a material with its grain size. (4 marks)

OR

14. a. Describe step by step procedure for metallographic specimen preparation? (10 marks)

b. Name the different types of etchants used for specific metals and the methods to determine grain size. (10 marks)

Module 3

15. a. Compare the advantages and limitations of carburising with flame hardening. (10 marks)

b. Explain how harden ability is determined from Jominy end quench test. (4 marks)

OR

16. Draw the isothermal transformation diagram of eutectoid steel and then sketch and label (i) A time temperature path that will produce 100% pure coarse and fine pearlite

(ii) A time temperature path that will produce 50% martensite and 50% bainite

(iii) A time temperature path that will produce 100% martensite

(iv) A time temperature path that will produce 100% bainite (14 marks)

Module 4

17. a. How are properties of steel affected by the inclusion of (i) tungsten and (ii) nickel as alloying elements? (4 marks)

b. Give the microstructure, properties and applications of graycast iron and white cast iron. (10 marks)

OR

18. Classify composites based on reinforcement characteristics. Give three applications of composites in automotive and aerospace industries. (14 marks)

Module 5

19. a. Why brittle materials fail at a value much lower than its theoretical cohesive strength under tensile loading? (4 marks)

b. What is ductile to brittle transition in steel DBTT? What are the factors affecting ductile to brittle transition? Narrate with neat sketch. (10 marks)

OR

20. a. Explain the procedure for creep test and the different stages of a creep curve. (10 marks)

b. Give the application of super plasticity in blow moulding process. (4 marks)

SYLLABUS

MODULE - 1

Atomic bonds: Primary bonds and secondary bonds - properties based on atomic bonding

Crystallography: Crystal structures - coordination number - APF - short and long range order - crystalline and amorphous structure - theoretical density - Polymorphism

Miller Indices: Crystal plane and direction

Modes of plastic deformation: Slip and twinning - Schmid's law - slip systems

MODULE - II

Crystallization: Homogeneous and heterogeneous nuclei formation - under cooling - Hall-Petch theory - effect of grain size - grain boundaries.

Classification of crystal imperfections: Point defects - dislocations - forest of dislocation, - Burgers vector - Frank Read source - correlation of dislocation density with strength - driving force for grain growth and applications

Microstructure analysis: Polishing and etching - X-ray diffraction, simple problems - SEM and TEM

Diffusion in solids: Fick's laws - mechanisms - applications of diffusion in engineering - factors affecting

MODULE - III

Solid solutions: Need of alloying - classification of alloys - types of solid solution - Hume Rothery's rules

Phase diagrams: Gibbs' phase - isomorphous and eutectic systems - coring - lever rule and tie line - invariant reactions - Iron-Carbon equilibrium diagram with microstructure and properties

Heat treatment: TTT and CCT diagram with applications - types of processes - hardenability - Jominy end quench test - surface hardening methods

MODULE - IV

Alloy steels: Effect of adding alloying elements in steel - high speed steels - stainless steel

Cast iron: Types with microstructure, properties and applications

Non-ferrous alloys: Alloys of aluminium, copper, nickel and magnesium - alloys used in automobiles

Composites and ceramics: Need, classification, properties, applications

Modern materials: Super alloys - nano materials - smart materials - materials used in automotive application

MODULE - V

Strengthening mechanisms: Cold and hot working - strain hardening - precipitation hardening - recovery, recrystallization and grain growth during annealing - Bauschinger effect

Fatigue: Mechanism - factors affecting fatigue life - fatigue test - S-N curve - endurance limit - methods to improve fatigue life - thermal fatigue

Fracture: Ductile and brittle fracture - Griffith's theory - DBTT - stress concentration - transgranular and intergranular fracture

Creep: Mechanism - creep test - creep curve - prevention against creep - super plasticity

Text Books

1. Callister William. D., Material Science and Engineering, John Wiley, 2014
2. Higgins R.A. - Engineering Metallurgy part - I – ELBS,1998

Reference

1. Avner H Sidney, Introduction to Physical Metallurgy, Tata McGraw Hill,2009
2. Anderson J.C. et.al., Material Science for Engineers, Chapman and Hall,1990
3. Clark and Varney, Physical metallurgy for Engineers, Van Nostrand,1964
4. Dieter George E, Mechanical Metallurgy, Tata McGraw Hill, 1976
5. Raghavan V, Material Science and Engineering, Prentice Hall,2004
6. Jose S and Mathew E V, Metallurgy and Material Science, Pentagon, 2020
7. Myers Marc and Krishna Kumar Chawla, Mechanical behavior of materials, Cambridge University press,2008
8. Van Vlack -Elements of Material Science - Addison Wesley,1989
9. <https://nptel.ac.in/courses/113/106/113106032>

COURSE CONTENTS AND LECTURE SCHEDULE

Module	TOPIC	No. of hours
1	MODULE 1 (9 HOURS)	
1.1	Basic atomic bonds: Primary bonds - characteristics of covalent, ionic and metallic bond - secondary bonds - hydrogen bonds - directional and non-directional - properties based on atomic bonding	1
1.2	Crystallography: Crystal, space lattice, unit cell - crystal systems, Bravais lattices - SC, BCC, FCC, HCP atomic packing factor - short and long range order - effects of crystalline and amorphous structure on mechanical properties.	2
1.3	Coordination number and radius ratio - theoretical density (simple problems) Polymorphism and allotropy	2
1.4	Miller Indices: Crystal plane and direction - attributes of miller indices for slip system - brittleness of BCC, HCP and ductility of FCC	2
1.5	Modes of plastic deformation: Slip and twinning - Schmid's law - critical resolved shear stress - correlation of slip system with plastic deformation in metals and applications.	2
2	MODULE 2 (10 HOURS)	

AUTOMOBILE ENGINEERING

2.1	Mechanism of crystallization: Homogeneous and heterogeneous nuclei formation - under cooling - dendritic growth - grain boundary Effects of grain size, grain size distribution, grain shape, grain orientation on dislocation/strength and creep resistance - Hall-Petch theory (simple problems)	2
2.2	Classification of crystal imperfections: - types of point defects and dislocations - Burgers vector	2
2.3	Effect of point defects on mechanical properties - forest of dislocation, role of surface defects on crack initiation - significance of high and low angle grain boundaries on dislocation - driving force for crystallization and grain growth	1
2.4	Significance of Frank-Read source in metals deformation - Correlation of dislocation density with strength of material - Jogs and kinks	1
2.5	Microstructure analysis: Polishing and etching to determine the microstructure and grain size Fundamentals and crystal structure determination by XRD, SEM and TEM	2
2.6	Diffusion in solids: Fick's laws, mechanisms, applications of diffusion in engineering, factors affecting (simple problems)	2
3	MODULE 3(9 HOURS)	
3.1	Solid solutions: Limitations of pure metals and need of alloying - classification of alloys, solid solutions, Hume Rothery's rule	1
3.2	Phase diagrams: Gibb's phase -unary system - isomorphous and eutectic systems - coring - lever rule and tie line - invariant reactions - monotectic, eutectic, eutectoid, peritectic, peritectoid	2
3.3	Detailed discussion on Iron-Carbon equilibrium diagram with microstructure and properties changes in austenite, pearlite, ledeburite, ferrite, cementite - special features of martensite transformation, bainite, etc. Microstructure of eutectoid, hypo and hyper eutectoid steel	2
3.4	Heat treatment: Definition and necessity - TTT for a eutectoid steel, CCT diagram, applications - annealing, normalizing, hardening, spheroidizing, tempering - tempering of martensite	2
3.5	Hardenability - Jominy end quench test - factors affecting hardenability Surface hardening methods with applications: No change in surface composition: flame, induction, laser and electron beam hardening processes - change in surface composition: carburizing and nitriding	2
4	MODULE 4(11 HOURS)	

AUTOMOBILE ENGINEERING

4.1	Alloy steels: Effects of alloying elements in steel - dislocation movement, polymorphic transformation temperature, alpha and beta stabilizers, formation and stability of carbides, grain growth, displacement of the eutectoid point, retardation of the transformation rates, improvement in corrosion resistance, mechanical properties Change of steel properties by adding alloying elements: Molybdenum, Nickel, Chromium, Vanadium, Tungsten, Cobalt, Silicon and Copper	2
4.2	High speed steels - W and Mo types, properties Stainless steel: Composition, properties and applications Cast irons: Gray, white, malleable and spheroidal graphite cast iron with composition, microstructure, properties and applications	2
4.3	Principal non-ferrous alloys: Aluminum, copper, nickel and magnesium - study of composition, properties, applications (reference shall be made to the application of alloys in automotive sector whenever necessary)	2
4.4	Composites: Need of development of composites - reinforcement phase - matrix phase; classification based on reinforcement characteristics and matrix material - need and characteristics of PMC, MMC, and CMC - fibre reinforced composites - applications (reference shall be made to the application of composites in automotive sector whenever necessary)	2
4.5	Ceramics: Classification based on application - properties - applications - coordination number and radius ratios - AX, AmXp, AmBmXp type structures (reference shall be made to the application of ceramics in automotive sector whenever necessary)	1
4.6	Modern engineering materials: Only fundamentals, need, properties and applications of super alloys, nano materials, and smart materials (reference shall be made to the application of materials in automotive sector such as batteries of electric vehicle, etc)	2
5	MODULE 5(9 HOURS)	
5.1	Strengthening mechanisms: Recrystallization temperature - hot working and cold working - detailed discussion on strain hardening - precipitation hardening Stages in annealing process: recovery, recrystallization and grain growth - Bauschinger effect and attributes in metalforming	2
5.2	Fatigue: - Stress cycles - characteristics and mechanism of fatigue failure - fatigue tests - S-N curve - endurance limit - factors affecting fatigue strength: stress concentration, size effect, surface	2

AUTOMOBILE ENGINEERING

	roughness, change in surface properties, surface residual stress - ways to improve fatigue life - effect of temperature on fatigue, thermal fatigue - fatigue failure of automobile parts	
5.3	Fracture: Brittle and ductile fracture - Griffith's theory of brittle fracture - stress concentration - stress raiser - effect of plastic deformation on crack propagation - transgranular and intergranular fracture - fracture toughness (definition only) Ductile to brittle transition temperature (DBTT) in steels and structural changes during DBTT - applications	3
5.4	Creep: Creep curves - creep tests - mechanism of creep deformation - threshold for creep - factors affecting creep rate - prevention against creep Super plasticity: Need and applications	2

HUT 310	Management for Engineers	Category	L	T	P	Credit
		HMC	3	0	0	3

Preamble: This course is intended to help the students to learn the basic concepts and functions of management and its role in the performance of an organization and to understand various decision-making approaches available for managers to achieve excellence. Learners shall have a broad view of different functional areas of management like operations, human resource, finance and marketing.

Prerequisite: Nil

Course Outcomes After the completion of the course the student will be able to

CO1	Explain the characteristics of management in the contemporary context (Cognitive Knowledge level: Understand).
CO2	Describe the functions of management (Cognitive Knowledge level: Understand).
CO3	Demonstrate ability in decision making process and productivity analysis (Cognitive Knowledge level: Understand).
CO4	Illustrate project management technique and develop a project schedule (Cognitive Knowledge level: Apply).
CO5	Summarize the functional areas of management (Cognitive Knowledge level: Understand).
CO6	Comprehend the concept of entrepreneurship and create business plans (Cognitive Knowledge level: Understand).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				1	2	2	2		2	1	1
CO2	2				1	1		2	1	2	1	1
CO3	2	2	2	2	1							
CO4	2	2	2	2	1						2	1
CO5	2					1	1		1	2	1	
CO6		2	2	2	1	1	1	1	1	1	1	1

Abstract POs defined by National Board of Accreditation			
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination (Marks in percentage)
Remember	15	15	30
Understand	15	15	30
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

HUT 310 Management for Engineers (35 hrs)

Module 1 (Introduction to management Theory- 7 Hours)

Introduction to management theory, Management Defined, Characteristic of Management, Management as an art-profession, System approaches to Management, Task and Responsibilities of a professional Manager, Levels of Manager and Skill required.

Module 2 (management and organization- 5 hours)

Management Process, Planning types , Mission, Goals, Strategy, Programmes, Procedures, Organising, Principles of Organisation, Delegation, Span of Control, Organisation Structures, Directing, Leadership, Motivation, Controlling..

Module 3 (productivity and decision making- 7 hours)

Concept of productivity and its measurement; Competitiveness; Decision making process; decision making under certainty, risk and uncertainty; Decision trees; Models of decision making.

. Module 4 (project management- 8 hours)

Project Management, Network construction, Arrow diagram, Redundancy. CPM and PERT Networks, Scheduling computations, PERT time estimates, Probability of completion of project, Introduction to crashing.

Module 5 (functional areas of management- 8 hours)

Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management, Entrepreneurship, Business plans, Corporate social responsibility, Patents and Intellectual property rights.

References:

1. H. Koontz, and H. Weihrich, Essentials of Management: An International Perspective. 8th ed., McGraw-Hill, 2009.
2. P C Tripathi and P N Reddy, Principles of management, TMH, 4th edition, 2008.
3. P. Kotler, K. L. Keller, A. Koshy, and M. Jha, Marketing Management: A South Asian Perspective. 14th ed., Pearson, 2012.
4. M. Y. Khan, and P. K. Jain, Financial Management, Tata-McGraw Hill, 2008.
5. R. D. Hisrich, and M. P. Peters, Entrepreneurship: Strategy, Developing, and Managing a New Enterprise, 4th ed., McGraw-Hill Education, 1997.
6. D. J. Sumanth, Productivity Engineering and Management, McGraw-Hill Education, 1985.
7. K. Ashwathappa, 'Human Resources and Personnel Management', TMH, 3rd edition, 2005.
8. R. B. Chase, Ravi Shankar and F. R. Jacobs, Operations and Supply Chain Management, 14th ed. McGraw Hill Education (India), 2015.

Sample Course Level Assessment Questions

Course Outcome1 (CO1): Explain the systems approach to management?

Course Outcome 2 (CO2): Explain the following terms with a suitable example Goal, Objective, and Strategy.

Course Outcome 3 (CO3): Mr. Shyam is the author of what promises to be a successful novel. He has the option to either publish the novel himself or through a publisher. The publisher is offering Mr. Shyam Rs. 20,000 for signing the contract. If the novel is successful, it will sell 200,000 copies. Else, it will sell 10,000 copies only. The publisher pays a Re. 1 royalty per copy. A market survey indicates that there is a 70% chance that the novel will be successful. If Mr. Shyam undertakes publishing, he will incur an initial cost of Rs. 90,000 for printing and marketing., but each copy sold will net him Rs. 2. Based on the given information and the

decision analysis method, determine whether Mr. Shyam should accept the publisher's offer or publish the novel himself.

Course Outcome 4 (CO4): Explain the concepts of crashing and dummy activity in project management.

Course Outcome 5 (CO5): Derive the expression for the Economic order quantity (EOQ)?

Course Outcome 6 (CO6): Briefly explain the theories of Entrepreneurial motivation.?

Model Question Paper

QP CODE:

PAGES: 4

Reg No: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

Course Code: HUT 310

Course name: Management for Engineers

Max Marks: 100

Duration: 3 Hours

PART-A (Answer All Questions. Each question carries 3 marks)

1. “Management is getting things done through other.” Elaborate.
2. Comment on the true nature of management. Is it a science or an art?
3. Planning is looking ahead and controlling is looking back. Comment with suitable examples
4. Explain the process of communication?
5. Explain the hierarchy of objectives?
6. Explain the types of decisions?
7. Describe the Economic man model?
8. Explain the concepts of crashing and dummy activity in project management.
9. Differentiate the quantitative and qualitative methods in forecasting.
10. What are the key metrics for sustainability measurement? What makes the measurement and reporting of sustainability challenging?

PART-B (Answer any one question from each module)

11. a) Explain the systems approach to management. (10)
b) Describe the roles of a manager (4)

OR

12. a) Explain the 14 principles of administrative management? (10)

b) Explain the different managerial skills (4)

13. a) What are planning premises, explain the classification of planning premises. (10)

b) Distinguish between strategy and policy. How can policies be made effective. (4)

OR

14 a) Explain three motivational theories. (9)

b) Describe the managerial grid. (5)

15. a) Modern forest management uses controlled fires to reduce fire hazards and to stimulate new forest growth. Management has the option to postpone or plan a burning. In a specific forest tract, if burning is postponed, a general administrative cost of Rs. 300 is incurred. If a controlled burning is planned, there is a 50% chance that good weather will prevail and burning will cost Rs. 3200. The results of the burning may be either successful with probability 0.6 or marginal with probability 0.4. Successful execution will result in an estimated benefit of Rs. 6000, and marginal execution will provide only Rs. 3000 in benefits. If the weather is poor, burning will be cancelled incurring a cost of Rs. 1200 and no benefit. i) Develop a decision tree for the problem.

(ii) Analyse the decision tree and determine the optimal course of action. (8)

b) Student tuition at ABC University is \$100 per semester credit hour. The Education department supplements the university revenue by matching student tuition, dollars per dollars. Average class size for typical three credit course is 50 students. Labour costs are \$4000 per class, material costs are \$20 per student, and overhead cost are \$25,000 per class. (a) Determine the total factor productivity. (b) If instructors deliver lecture 14 hours per week and the semester lasts for 16 weeks, what is the labour productivity? (6)

OR

16. a) An ice-cream retailer buys ice cream at a cost of Rs. 13 per cup and sells it for Rs. 20 per cup; any remaining unsold at the end of the day, can be disposed at a salvage price of Rs. 2.5 per cup. Past sales have ranged between 13 and 17 cups per day; there is no reason to believe that

sales volume will take on any other magnitude in future. Find the expected monetary value and EOL, if the sales history has the following probabilities:
(9)

Market Size	13	14	15	16	17
Probability	0.10	0.15	0.15	0.25	0.35

b) At Modern Lumber Company, Kishore the president and a producer of an apple crates sold to growers, has been able, with his current equipment, to produce 240 crates per 100 logs. He currently purchases 100 logs per day, and each log required 3 labour hours to process. He believes that he can hire a professional buyer who can buy a better quality log at the same cost. If this is the case, he increases his production to 260 crates per 100 logs. His labour hours will increase by 8 hours per day. What will be the impact on productivity (measured in crates per labour-hour) if the buyer is hired? What is the growth in productivity in this case?
(5)

17. a) A project has the following list of activities and time estimates:

Activity	Time (Days)	Immediate Predecessors
A	1	-
B	4	A
C	3	A
D	7	A
E	6	B
F	2	C, D
G	7	E, F
H	9	D
I	4	G, H

(a) Draw the network. (b) Show the early start and early finish times. (c) Show the critical path.
(10)

MCN 301	DISASTER MANAGEMENT	Category	L	T	P	CREDIT	YEAR OF INTRODUCTION
		Non - Credit	2	0	0	Nil	2019

Preamble: The objective of this course is to introduce the fundamental concepts of hazards and disaster management.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Define and use various terminologies in use in disaster management parlance and organise each of these terms in relation to the disaster management cycle (Cognitive knowledge level: Understand).
CO2	Distinguish between different hazard types and vulnerability types and do vulnerability assessment (Cognitive knowledge level: Understand).
CO3	Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk (Cognitive knowledge level: Understand).
CO4	Explain the core elements and phases of Disaster Risk Management and develop possible measures to reduce disaster risks across sector and community (Cognitive knowledge level: Apply)
CO5	Identify factors that determine the nature of disaster response and discuss the various disaster response actions (Cognitive knowledge level: Understand).
CO6	Explain the various legislations and best practices for disaster management and risk reduction at national and international level (Cognitive knowledge level: Understand).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2				2				2		2
CO2	2	3	2		2	2	3			3		2
CO3	2	3	2	2	2	2	3			3		2
CO4	3	3	3		2	2	3					2
CO5	3	3			2	2	3					2
CO6	3					2	3	3				2

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	20
Understand	25	25	50
Apply	15	15	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A.

Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

MCN 301 Disaster Management

Module 1

Systems of earth

Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland water bodies; biosphere

Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.

Module 2

Hazard types and hazard mapping; Vulnerability types and their assessment- physical, social, economic and environmental vulnerability.

Disaster risk assessment –approaches, procedures

Module 3

Disaster risk management -Core elements and phases of Disaster Risk Management

Measures for Disaster Risk Reduction – prevention, mitigation, and preparedness.

Disaster response- objectives, requirements; response planning; types of responses.

Relief; international relief organizations.

Module 4

Participatory stakeholder engagement; Disaster communication- importance, methods, barriers; Crisis counselling

Capacity Building: Concept – Structural and Non-structural Measures, Capacity Assessment; Strengthening Capacity for Reducing Risk

Module 5

Common disaster types in India; Legislations in India on disaster management; National disaster management policy; Institutional arrangements for disaster management in India.

The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles

Reference Text Book

1. R. Subramanian, Disaster Management, Vikas Publishing House, 2018
2. M. M. Sulphery, Disaster Management, PHI Learning, 2016
3. UNDP, Disaster Risk Management Training Manual, 2016
4. United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. Explain the different types of cyclones and the mechanism of their formation
4. Explain with examples, the difference between hazard and risk in the context of disaster management
5. Explain the following terms in the context of disaster management (a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

Course Outcome 2 (CO2):

1. What is hazard mapping? What are its objectives?
2. What is participatory hazard mapping? How is it conducted? What are its advantages?
3. Explain the applications of hazard maps
4. Explain the types of vulnerabilities and the approaches to assess them

Course Outcome 3 (CO3):

1. Explain briefly the concept of 'disaster risk'

2. List the strategies for disaster risk management ‘before’, ‘during’ and ‘after’ a disaster
3. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy

Course Outcome 4 (CO4):

1. What is disaster prevention? Distinguish it from disaster mitigation giving examples
2. What are the steps to effective disaster communication? What are the barriers to communication?
3. Explain capacity building in the context of disaster management

Course Outcome 5 (CO5):

1. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
2. Explain the importance of communication in disaster management
3. Explain the benefits and costs of stakeholder participation in disaster management
4. How are stakeholders in disaster management identified?

Course Outcome 6 (CO6):

1. Explain the salient features of the National Policy on Disaster Management in India
2. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction
3. What are Tsunamis? How are they caused?
4. Explain the earthquake zonation of India

Model Question paper

QP CODE:

PAGES:3

Reg No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MCN 301

Course Name: Disaster Management

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. What is hazard mapping? What are its objectives?
4. Explain briefly the concept of 'disaster risk'
5. List the strategies for disaster risk management 'before', 'during' and 'after' a disaster
6. What is disaster prevention? Distinguish it from disaster mitigation giving examples
7. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
8. Explain the importance of communication in disaster management
9. What are Tsunamis? How are they caused?
10. Explain the earthquake zonation of India

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. a. Explain the different types of cyclones and the mechanism of their formation [10]
b. Explain with examples, the difference between hazard and risk in the context of disaster management [4]

OR

12. Explain the following terms in the context of disaster management [14]
(a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

13. a. What is participatory hazard mapping? How is it conducted? What are its advantages? [8]
b. Explain the applications of hazard maps [6]

OR

14. Explain the types of vulnerabilities and the approaches to assess them [14]
15. a. Explain the core elements of disaster risk management [8]
b. Explain the factors that decide the nature of disaster response [6]

OR

16. a. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy [6]
b. Explain the different disaster response actions [8]
17. a. Explain the benefits and costs of stakeholder participation in disaster management [10]
b. How are stakeholders in disaster management identified? [4]

OR

18. a. What are the steps to effective disaster communication? What are the barriers to communication? [7]
b. Explain capacity building in the context of disaster management [7]

19. Explain the salient features of the National Policy on Disaster Management in India

[14]

OR

20. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction

[14]

Teaching Plan

	Module 1	5 Hours
1.1	Introduction about various Systems of earth, Lithosphere-composition, rocks, Soils; Atmosphere-layers, ozone layer, greenhouse effect, weather	1 Hour
1.2	Cyclones, atmospheric circulations, Indian Monsoon; hydrosphere-Oceans, inland water bodies; biosphere	1 Hour
1.3	Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard,	1 Hour
1.4	Exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, Disaster risk management, early warning systems	1 Hour
1.5	Disaster preparedness, disaster prevention, disaster, Mitigation, disaster response, damage assessment, crisis counselling, needs assessment.	1 Hour
	Module 2	5 Hours
2.1	Various Hazard types, Hazard mapping; Different types of Vulnerability types and their assessment	1 Hour
2.2	Vulnerability assessment and types, Physical and social vulnerability	1 Hour
2.3	Economic and environmental vulnerability, Core elements of disaster risk assessment	1 Hour
2.4	Components of a comprehensive disaster preparedness strategy approaches, procedures	1 Hour
2.5	Different disaster response actions	1 Hour
	Module 3	5 Hours
3.1	Introduction to Disaster risk management, Core elements of Disaster Risk Management	1 Hour
3.2	Phases of Disaster Risk Management, Measures for Disaster Risk Reduction	1 Hour
3.3	Measures for Disaster prevention, mitigation, and preparedness.	1 Hour

3.4	Disaster response- objectives, requirements. Disaster response planning; types of responses.	1 Hour
3.5	Introduction- Disaster Relief, Relief; international relief organizations.	1 Hour
	Module 4	5 Hours
4.1	Participatory stakeholder engagement	1 Hour
4.2	Importance of disaster communication.	1 Hour
4.3	Disaster communication- methods, barriers. Crisis counselling	1 Hour
4.4	Introduction to Capacity Building. Concept – Structural Measures, Non-structural Measures.	1 Hour
4.5	Introduction to Capacity Assessment, Capacity Assessment; Strengthening, Capacity for Reducing Risk	1 Hour
	Module 5	5 Hours
5.1	Introduction-Common disaster types in India.	1 Hour
5.2	Common disaster legislations in India on disaster management	1 Hour
5.3	National disaster management policy, Institutional arrangements for disaster management in India.	1 Hour
5.4	The Sendai Framework for Disaster Risk Reduction and targets	1 Hour
5.5	The Sendai Framework for Disaster Risk Reduction-priorities for action, guiding principles	1 Hour

AUTOMOBILE ENGINEERING

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUL331	PRODUCTION ENGINEERING LAB	PCC	0	0	3	2

Preamble: The lab provides basic application of the following:

- Types of machining to be selected for the manufacturing of components
- Parameters and optimisation of the machining parameters for better outputs
- Understand the different joining process employed in manufacturing
- Enumerate the basics of CNC machining and its methodology

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Identify the machining operation involved for a component
CO 2	Illustrate the manufacturing sequence for developing a component
CO 3	Apply and optimise different criteria for machining of a component
CO 4	Develop and analyse a CNC programme using simulation software
CO 5	Enhance research capabilities by carrying out different research oriented experiments

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	-	-	-	-	-	-	-	-	2	3	1	1
CO 2	-	-	-	-	-	-	-	-	2	3	1	1
CO 3	-	-	-	-	-	-	-	-	2	3	1	2
CO 4	-	1	-	-	2	-	-	-	2	3	1	2
CO 5	1	2	-	-	3	-	-	-	2	3	1	2

Course Level Assessment Questions

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30 marks

AUTOMOBILE ENGINEERING

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

- | | |
|--|------------|
| (a) Preliminary work | : 15 Marks |
| (b) Implementing the work/Conducting the experiment | : 10 Marks |
| (c) Performance, result and inference (usage of equipments and trouble shooting) | : 25 Marks |
| (d) Viva voce | : 20 marks |
| (e) Record | : 5 Marks |

General instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Reference Books

1. R. K. Jain, "Production Technology", Khanna Publishers, 18th Edition, 2013.
2. B. S. Raghuvamshi, "A Course in Workshop Technology", Dhanpat Rai & Sons, 2014.
3. Kalpakjian S, "Manufacturing Engineering and Technology", Pearson Education, 7th edition, 2014.
4. HMT, "Production Technology", McGraw-Hill Education, 1st Edition, 2008

List of Exercises/Experiments: (Lab experiments may be given considering 12 sessions of 3 hours each.)

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses
11. Gas welding experiment
12. Arc welding experiment
13. Resistance welding experiment.
14. Soldering & Brazing experiment
15. CNC Programming Simulation using any software
16. CNC machining in CNC Lathe
17. CNC Milling in a VMC
18. Metal Cutting Experiments (Example: Cutting Force Measurement, Cutting Temperature Measurement etc.)

AUTOMOBILE ENGINEERING

CODE MEL333	COURSE NAME: THERMAL ENGINEERING LAB 1	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble: The course is intended to impart basic understanding on the working of internal combustion engines. This includes various performance tests on internal combustion engines as well as makes the students familiar with the evaluation of fuel properties such as viscosity, flash and fire points, calorific value etc. which are key to any performance test.

Prerequisite: Should have undergone a course on Thermal Engineering with emphasis on IC engines

Course Outcomes: After completion of the course the student will be able to

CO 1	Measure thermo-physical properties of solid, liquid and gaseous fuels
CO 2	Identify various systems and subsystems of Diesel and petrol engines
CO 3	Analyse the performance characteristics of internal combustion engines
CO 4	Investigate the emission characteristics of exhaust gases from IC Engines
CO 5	Interpret the performance characteristics of air compressors / blowers

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3		2	3			2		3	2		2
CO 2	3		2	3			2		3	2		2
CO 3	3		2	3			2		3	2		2
CO 4	3		2	3			2		3	2		2
CO 5	3		2	3			2		3	2		2

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

AUTOMOBILE ENGINEERING

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting)	: 25 Marks
(d) Viva voce	: 20 marks
(e) Record	: 5 Marks

General instructions:

Practical examination is to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

List of Exercises/Experiments: (Lab experiments may be given considering 12 sessions of 3 hours each. Minimum 12 experiments to be performed.)

1. Determination of flash and fire points of petroleum fuels and oils
2. Determination of viscosity of lubricating oils and fuels and its variation with temperature
3. Determination of calorific value of solid and liquid fuels- Bomb Calorimeter
4. Determination of calorific value of gaseous fuels –Gas Calorimeter
5. Familiarisation of various systems and subsystems of petrol engine / MPFI engine
6. Familiarisation of various systems and parts of Diesel engine / Turbocharged engine
7. Performance test on petrol engines / MPFI engine
8. Performance test on Diesel engines / Turbocharged engine
9. Heat Balance test on petrol/Diesel engines
10. Determination volumetric efficiency and Air-fuel ratio of IC engines
11. Cooling curve of IC engines
12. Valve timing diagram of IC engines
13. Economic speed test on IC engines
14. Retardation test on IC engines
15. Morse test on petrol engine
16. Experiment to find flame temperature of premixed flames at different equivalence ratios and temperature of diffusion flames at different fuel flow rates.
17. Analysis of automobile exhaust gas and flue gas using exhaust gas analyser.
18. Performance test on reciprocating compressor
19. Performance test on rotary compressor/blower

Reference Books

1. J.B.Heywood, I.C engine fundamentals, McGraw-Hill, 2017
2. V. Ganesan, Fundamentals of IC engines, Tata McGraw-Hill, 2017
3. Stephen R Turns, An Introduction to Combustion: Concepts and Applications, McGraw-Hill, 2017

APJ ABDUL KALAM
TECHNOLOGICAL
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SEMESTER VI



AUTOMOBILE ENGINEERING

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MET302	HEAT & MASS TRANSFER	PCC	3	1	0	4

Preamble: The objectives of the course are:

- To introduce the various modes of heat transfer and to develop methodologies for solving a wide variety of practical heat transfer problems
- To provide useful information concerning the performance and design of simple heat transfer systems
- Conceive the energy balance in any thermal practical situation involving heat transfer mechanisms.
- To introduce mass transfer.

Prerequisite: MET203 Mechanics of Fluids, MET202 Engineering Thermodynamics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply principles of heat and mass transfer to engineering problems
CO 2	Analyse and obtain solutions to problems involving various modes of heat transfer
CO 3	Design heat transfer systems such as heat exchangers, fins, radiation shields etc.
CO 4	Define laminar and turbulent boundary layers and ability to formulate energy equation in flow systems.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2									1
CO 2	3	3	3									2
CO 3	3	3	3									2
CO 4	3	3	3									2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	10	20
Apply	10	20	50
Analyse	10	10	20
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10marks
 Continuous Assessment Test(2numbers) : 25
 marks Assignment/Quiz/Course project :
 15marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. A furnace wall is made up of three layers of thicknesses 250 mm, 100 mm and 150 mm with thermal conductivities of 1.65 W/m.K and 9.2 W/m.K respectively. The inside is exposed to gases at 1250 °C with a convection coefficient of 25 W/m².K. and the inside surface is at 1100 °C, the outside surface is exposed to air at 25 °C with convection coefficient of 12 W/m².K. Determine (a) the unknown thermal conductivity K (b) the overall heat transfer coefficient (c) all the intermediate temperatures?
2. Derive an expression for steady state temperature distribution in a slab with internal heat generation.
3. Dry air at 300 °C and 1 atm flows over a wet flat plate 600 mm. long at a velocity of 50 m/s. Calculate the mass transfer co-efficient of water vapour in air at the end of the plate. Take the diffusion co-efficient of water vapour in air, $D = 0.26 \times 10^{-4} \text{ m}^2/\text{s}$.

Course Outcome 2 (CO2)

1. Discuss the importance of non-dimensional numbers in heat transfer problems.
2. A hollow sphere ($k = 65 \text{ W/m.K}$) of 120 mm inner diameter and 350 mm outer diameter is covered 10 mm layer of insulation ($k = 10 \text{ W/m.K}$). The inside and outside temperatures are 500 °C and 50 °C respectively. Calculate the rate of heat flow through this sphere.

3. A steel ball (specific heat $=0.46 \text{ kJ/kg.K}$, and thermal conductivity 35 W/m.K) having 5 cm diameter and initially at a uniform temperature of 450°C is suddenly placed in a control environment in which the temperature is maintained at 100°C . Calculate the time required for the ball to attain a temperature of 150°C .

Course Outcome 3(CO3):

1. Water at the rate of 4 kg/s is heated from 40°C to 55°C in a shell and tube heat exchanger. On the shell side one pass is used with water as the heating fluid and at a mass flow rate of 2 kg/s , and entering the heat exchanger at 95°C . The overall heat transfer coefficient is $1500 \text{ W/m}^2\text{K}$. and the average water velocity in the 2 cm diameter tubes is 0.5 m/s . Because of space limitations, the tube length must not exceed 3 m. Calculate the number of tube passes, the number of tubes per pass and the length of the tubes, keeping in mind the design constraints.
2. Two large plates, one at 800 K and other at 600 K have emissivities 0.5 and 0.8 respectively. A radiation shield having an emissivity 0.1 on one side and emissivity 0.05 on the other side is placed between the plates. Calculate the heat transfer by radiation per square meter with and without the radiation shield.
3. A rectangular aluminum fin of thermal conductivity 200 W/m.K , 3mm. thick and 7.5 cm long protrudes out from a wall. The fin base is maintained at a temperature of 300°C and the ambient temperature is 50°C with heat transfer coefficient $10 \text{ W/m}^2\text{K}$. The tip of the fin is insulated. Calculate the heat transfer from the fin per unit depth of material.

Course Outcome 4 (CO4):

1. Explain velocity boundary layer and thermal boundary layer with neat sketches.
2. Air at 40°C flows over a tube with a velocity of 30 m/s . The tube surface temperature is 120°C . Calculate the heat transfer coefficient for the following cases:
 - (i) Tube is square with a side of 6 cm
 - (ii) Tube is circular cylinder with a diameter of 6 cm.
3. Air at 20°C at atmospheric pressure flows over a flat plate at a velocity of 3 m/s . If the plate is 1 m wide and at 80°C , calculate the following at $x = 300 \text{ mm}$.
 - i. Hydrodynamic boundary layer thickness
 - ii. Thermal boundary layer thickness
 - iii. Local friction coefficient
 - iv. Average heat transfer coefficient
 - v. Heat transfer rate

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER MECHANICAL ENGINEERING

Heat and Mass Transfer-MET302

Maximum:100 Marks

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Discuss about the application of Heisler chart and Schmidt plot in heat transfer analysis.
2. How does a numerical solution method differ from analytical one? Explain.
3. What are the characteristics of a boundary layer?
4. Write the significance of Nusselt number.
5. What is meant by condensation heat transfer? How it differs from drop wise heat transfer?
6. What are the main factors to be considered for a heat exchanger design?
7. Explain about radiation shape factor.
8. What are the properties of blackbody?
9. Give two examples of mass transfer in day-to-day life.
10. Explain Ficks law of diffusion with suitable assumptions.

(10 X 3 = 30 Marks)

PART B

Answer one full question from each module

MODULE 1

11.

a) Derive 3-dimensional unsteady state heat conduction equation with heat generation, in Cartesian co-ordinate system for anisotropic material. (7Marks)

b) A 3 mm diameter and 5m long electric wire is tightly wrapped with a 2 mm thick plastic cover whose thermal conductivity is $k = 0.15 \text{ W/m-K}$. Electrical measurements indicate that a current of 10 A passes through the wire and there is a voltage drop of 8 V along the wire. If the insulated wire is exposed to a medium at $T_\infty = 30^\circ\text{C}$ with a heat transfer coefficient of $h = 12 \text{ W/m}^2\text{-K}$, determine the temperature at the interface of the wire and the plastic cover in steady operation. Also state with reason, whether doubling the thickness of the plastic cover will increase or decrease heat transfer.

(7 Marks)

12.

a) Derive an expression for temperature distribution for 1-dimensional slab with varying thermal conductivity. Assume the variation of thermal conductivity of slab as $k = k_0(1+\beta t)$.

(7Marks)

b) A square plate heater 15 cm x 15 cm is inserted between two slabs. Slab A is 2 cm thick ($k = 50\text{W/m-K}$) and Slab B is 1cm thick ($k = 0.2\text{W/m-K}$). The outside heat transfer coefficients on side A and side B are $200\text{W/m}^2\text{-K}$ and $50\text{W/m}^2\text{-K}$ respectively. The temperature of surrounding air is 25°C . If rating of heater is 1 KW, find (a) Maximum temperature in the system, and (b) outer surface temperature of the two slabs. (7Marks)

MODULE II

13.

a) Saturated propane at 300 K with a velocity of 25 cm/s flows over a flat plate of length $L=2 \text{ m}$. and width $w=1 \text{ m}$. maintained at uniform temperature of 400 K. Calculate the local heat transfer coefficient at 1 m. length and the average heat transfer coefficient from $L=0 \text{ m}$. to $L=2 \text{ m}$. Also find the heat transfer. (7Marks)

b) Hot air at atmospheric pressure and 80°C enters an 8 m. long uninsulated square duct of cross section $0.2 \text{ m.} \times 0.2 \text{ m.}$ that passes through the attic of a house at a rate of $0.15\text{m}^3/\text{s}$. The duct is observed to be nearly isothermal at 60°C . Determine the exit temperature of the air. (7Marks)

14.

a) Air at 15°C , 35 m/s, flows through a hollow cylinder of 4 cm. inner diameter and 6 cm. outer diameter and leaves at 45°C . The tube passes through a room where the room temperature is 65°C and tube wall is maintained at 60°C . Calculate the heat transfer coefficient between the air and the inner tube. (7Marks)

b) Consider a 0.6 m. x 0.6 m. thin square plate in a room at 30°C . One side of the plate is maintained at a temperature of 90°C , while the other side is insulated. Determine the rate of heat transfer from the plate by natural convection. If the emissivity of the surface is 1.0, calculate the heat loss by radiation. Also calculate the percentage of heat loss by convection. (7Marks)

MODULE III

15.

a) A counter flow double pipe heat exchanger is to heat water from 20°C to 80°C at a rate of 1.2kg/s. The heating is to be accomplished by geothermal water available at 170°C at a mass flow rate of 2 kg/s. The inner tube is thin walled and has a diameter of 1.5 cm. If the overall heat transfer coefficient of the heat exchanger is $640 \text{ W/m}^2\text{-K}$, determine the length of the heat exchanger required to achieve the desired heating. Use ϵ -NTU method. (8 Marks)

b) Derive an expression for LMTD of double pipe, parallel flow heat exchanger. (6 Marks)

16.

a) Steam in the condenser of a power plant is to be condensed at a temperature of 30°C with cooling water from a nearby lake, which enters the tubes of the condenser at 14°C and leaves at 22°C . The surface area of the tubes is 45 m^2 and the overall heat transfer coefficient is $2100 \text{ W/m}^2 \cdot ^{\circ}\text{C}$. Determine the mass flow rate of the cooling water needed and the rate of condensation of the steam in the condenser. (7Marks)

b) In a double pipe heat exchanger, hot fluid with a specific heat of 2300 J/kg enters at 380°C and leaves at 300°C . Cold fluid enters at 25°C and leaves at 210°C . Calculate the heat exchanger area required for (i) Counter flow and (ii) Parallel flow. Take overall heat transfer coefficient as $750 \text{ W/m}^2 \text{ K}$ and mass flow rate of hot fluid is 1 kg/s. (7Marks)

MODULE IV

17.

a) A 70 mm. thick metal plate with a circular hole of 35 mm. diameter along the thickness is maintained at a uniform temperature 250 °C. Find the loss of energy to the surroundings at 27 °C, assuming the two ends of the hole to be as parallel discs and the metallic surfaces and surroundings have blackbody characteristics. (6Marks)

b) Two large parallel planes with emissivities of 0.3 and 0.5 are maintained at temperatures of 527 °C and 127 °C respectively. A radiation shield having emissivities of 0.05 on both sides is placed between them. Calculate,

(i) Heat transfer rate between them without shield.

(ii) Heat transfer rate between them with shield.

(8 Marks)

18.

a) Two parallel plates of size 1.0 m. by 1.0 m. spaced 0.5 m apart are located in a very large room, the walls of which are maintained at a temperature of 27°C. One plate is maintained at a temperature of 900 °C and the other at 400 °C. Their emissivities are 0.2 and 0.5 respectively. If the plates exchange heat between themselves and the surroundings, find the net heat transfer to each plate and to the room. Consider only the plate surface facing each other.

(8Marks)

b) Two rectangular surfaces are perpendicular to each other with a common edge of 2 m. The horizontal plane is 2 m. long and vertical plane is 3 m long. Vertical plane is at 1200 K and has an emissivity of 0.4. the horizontal plane is 18 °C and has an emissivity of 0.3. Determine the net heat exchange between the planes. (6 marks)

MODULE V

19.

a) Explain the analogy between heat and mass transfer.

(6Marks)

b) Dry air at 30°C and 1 atm flows over a wet flat plate 600 mm. long at a velocity of 50 m/s. Calculate the mass transfer co-efficient of water vapour in air at the end of the plate. Take the diffusion co-efficient of water vapour in air, $D = 0.26 \times 10^{-4} \text{ m}^2/\text{s}$.

(8Marks)

20.

- a) Gaseous hydrogen is stored at elevated pressure in a rectangular steel container of 10 mm. wall thickness. The molar concentration of hydrogen in steel at the inner surface is 2 kg mol/m³, while the concentration of hydrogen in steel at the outer surface is 0.5 kg mol/m³. The binary diffusion coefficient for hydrogen in steel is 0.26×10^{-12} m²/s. What is the mass flux of hydrogen through the steel? (8Marks)
- b) Explain the phenomenon of equimolar counter diffusion. Derive an expression for equimolar counter diffusion between two gases or liquids. (6Marks)

Syllabus

Module 1-

CONDUCTION HEAT TRANSFER

Introduction to heat transfer- thermodynamics and heat transfer-typical heat transfer situations- modes of heat transfer- mechanism of heat transfer- basic laws of heat transfer- thermal conductivity-effect of temperature on thermal conductivity- combined heat transfer mechanism-real life situations of combined heat transfer.

Differential equations of heat conduction-boundary conditions and initial conditions, one dimensional steady state situations – plane wall, cylinder, sphere -concept of thermal resistance, critical radius, conduction with heat generation- Two-dimensional steady state situations, transient conduction, Lumped capacitance model, concept of Heisler chart and Schmidt Plot-Conduction shape factor- Numerical methods of analysis-thermal analysis of rectangular fins.

Module 2

CONVECTION HEAT TRANSFER

Fundamentals, order of magnitude analysis of momentum and energy equations; hydrodynamic and thermal boundary Layers-Relation between fluid friction and heat transfer- Concepts of fluid mechanics, Differential equation of heat convection, Laminar flow heat transfer in circular pipe – constant heat flux and constant wall temperature, thermal entrance region, Turbulent flow heat transfer in circular pipe, pipes of other cross sections, Heat transfer in laminar flow and turbulent flow over a flat plate, Reynolds analogy, Flow across a cylinder and sphere- Natural convection- basics- free convection heat transfer on a vertical flat plate-empirical relations for free convection heat transfer.

Module 3

HEAT EXCHANGERS

Condensation heat transfer phenomena- the condensation Number-Boiling heat transfer Phenomena- Simplified relations for boiling heat transfer-Introduction to heat exchangers- types of heat exchangers-the overall heat transfer coefficient-Fouling factor-LMTD analysis

of heat exchangers- effectiveness-NTU method-Analysis of variable properties-compact heat exchangers-heat exchanger design considerations.

Module 4

RADIATION HEAT TRANSFER

Physical mechanism of radiation heat transfer-Radiation properties-; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; Gray body Radiation shape factors-heat exchange between non -black bodies-Infinite parallel planes-Radiation combined with conduction and convection.

Module 5

MASS TRANSFER

Introduction to mass transfer- Molecular diffusion in fluids- Steady state molecular diffusion in fluids under stagnant and laminar flow conditions - Fick's law of diffusion-Types of solid diffusion- mass transfer coefficients in laminar and turbulent flows- Introduction to mass transfer coefficient- Equimolar counter-diffusion- Correlation for convective mass transfer coefficient- Correlation of mass transfer coefficients for single cylinder- Theories of mass transfer- Overall mass transfer coefficients.

Text Books

1. Sachdeva R.C., Fundamentals of Engineering Heat and Mass Transfer, New Age Science Limited, 2009
2. R.K.Rajput. Heat and mass transfer, S.Chand &Co., 2015
3. Nag P.K., Heat and Mass Transfer, McGrawHill, 2011
4. Kothandaraman C.P., Fundamentals of Heat and Mass Transfer, New Age International, New Delhi,2006

Data Book

Heat and Mass Transfer data book: C.P. Kothandaraman, S. Subramanya, New age International Publishers,2014

Reference Books

2. Holman J.P, "Heat transfer", Mc Graw-Hill, 10th. Ed.,2009.
3. Yunus A. Cengel, "Heat and Mass Transfer: Fundamentals and Applications" McGraw-Hill Higher Education; 6th edition,2019.
4. Frank P. Incropera and David P. Dewitt, Heat and Mass Transfer, John Wiley and sons,2011

Course Contents and Lecture Schedule

MODULE	TOPICS	HOURS ALLOTTED
1	Introduction to heat transfer- thermodynamics and heat transfer-typical heat transfer situations- modes of heat transfer-mechanism of heat transfer- basic laws of heat transfer-thermal conductivity-thermal conductivity-effect of temperature on thermal conductivity- combined heat transfer mechanism-real life situations of combined heat transfer.	2-0-0
	Differential equations of heat conduction-boundary conditions and initial conditions, one dimensional steady state situations – plane wall, cylinder, sphere -concept of thermal resistance, critical radius, conduction with heat generation- Two-dimensional steady state situations, transient conduction, Lumped capacitance model, concept of Heisler chart and Schmidt Plot-Conduction shape factor- Numerical methods of analysis- thermal analysis of rectangular fins.	6-4-0
2	Fundamentals, order of magnitude analysis of momentum and energy equations; hydrodynamic and thermal boundary Layers-Relation between fluid friction and heat transfer- Concepts of fluid mechanics, Differential equation of heat convection, Laminar flow heat transfer in circular pipe – constant heat flux and constant wall temperature, thermal entrance region, Turbulent flow heat transfer in circular pipe, pipes of other cross sections, Heat transfer in laminar flow and turbulent flow over a flat plate, Reynolds analogy, Flow across a cylinder and sphere- Natural convection- basics- free convection heat transfer on a vertical flat plate- empirical relations for free convection heat transfer.	6-4-0
3	Condensation heat transfer phenomena- the condensation Number- Boiling heat transfer Phenomena-Simplified relations for boiling heat transfer-Introduction to heat exchangers-types of heat exchangers-the overall heat transfer coefficient-Fouling factor-LMTD analysis of heat exchangers-effectiveness-NTU method-Analysis of variable properties- compact heat exchangers-heat exchanger design considerations.	5-2-0
4	Physical mechanism of radiation heat transfer-Radiation properties-; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; Gray body Radiation shape factors-heat exchange between non - black bodies-Infinite parallel planes-Radiation combined with conduction and convection.	5-2-0

5	Introduction to mass transfer- Molecular diffusion in fluids- Steady state molecular diffusion in fluids under stagnant and laminar flow conditions - Fick's law of diffusion-Types of solid diffusion- mass transfer coefficients in laminar and turbulent flows- Introduction to mass transfer coefficient- Equimolar counter-diffusion- Correlation for convective mass transfer coefficient- Correlation of mass transfer coefficients for single cylinder- Theories of mass transfer- Overall mass transfer coefficients	7-2-0
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AUTOMOBILE ENGINEERING

AUT304	AUTOMOTIVE ELECTRICAL AND ELECTRONICS	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: The aim of this subject is to offer the students a general understanding of various automotive electrical and electronic systems used in automobiles.

- ✓ Explain the construction of battery used in automotive vehicles.
- ✓ Describe the construction and working of D.C. generator, alternator, cranking motor.
- ✓ Explain the working of ignition systems along with trouble shooting.
- ✓ Discuss the various parts of lighting system.
- ✓ Use transducers and sensors in electronic circuits.

Prerequisite: Basic Electrical Engineering and Basic Electronics Engineering

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand constructional details and working of various batteries used in automotive vehicles
CO 2	Discuss the construction and working of starter motor and alternator
CO 3	Explain the construction and working of battery ignition system and also working of electronic fuel injection system.
CO 4	Explain the different types of components that make up the lighting systems
CO 5	Understand the working of various sensors used in automobiles

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	1	-	-	-	-	-	-	-	-	-
CO 2	3	-	1	-	-	-	-	-	-	-	-	-
CO 3	3	-	1	-	-	-	-	-	-	-	-	-
CO 4	3	-	1	-	-	-	-	-	-	-	-	-
CO 5	3	-	1	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50

AUTOMOBILE ENGINEERING

Apply			
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the construction and working of lead acid battery?
2. Explain the working of Starter motor?
3. Explain the construction and working of alternator?

Course Outcome 2 (CO2)

1. Explain the construction and working of starter motor system?
2. What are the components that make up the charging system in an automobile? the purpose of each?

Course Outcome 3(CO3):

1. What is the importance of ignition timing in an SI engine?
2. How sparkplug operates?

Course Outcome 4 (CO4):

1. Explain the working of lighting system in automobiles?

2. What are the various other lights used in automobiles other than head light? State the purpose of each?

Course Outcome 5 (CO5):

1. Explain the working of Hall effect sensor?
2. Explain how the engine crankshaft position is determined using the Crankshaft Position Sensor (CPS)?

Model Question paper

QP CODE:

2

PAGES:

Reg. No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT304

Course Name: AUTOMOTIVE ELECTRICAL AND ELECTRONICS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. What is the purpose of cut-out relay in a charging system?
2. How alkaline battery differs from lead acid battery?
3. What are the different types of starting drives and starting switches?
4. What is the working principle of alternator?
5. Explain the working of vacuum advance mechanism?
6. Explain the working of centrifugal advance mechanism?
7. Explain the working of LED display device?
8. How does coolant temperature indicators work?
9. How does optical sensor work?
10. Explain the working of knock sensor?

PART B

Answer any one full question from each module.

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Each question carries 14 Marks

Module 1

11. What are the various battery tests conducted to access the state of charge of battery? Explain any three tests. (14)

Or

12. Explain the constructional details of Lead Acid battery with necessary sketches. (14)

Module 2

13. a) What is Rectification in a Charging system? (7)
b) Explain about half-wave and full wave rectification with neat sketch. (7)

Or

14. a) Explain with full circuit, working principle of three phase alternator. (7)
b) Differentiate between single phase and three phase alternators with proper diagrams. (7)

Module 3

15. a) Explain about the spark plug and its constructional details (7)
b) With a neat sketch Explain the working of an electric horn. (7)

Or

16. Describe a high-tension magneto ignition system with figure and state its advantages and disadvantages. (14)

Module 4

17. Draw a simplified wiring circuit for a typical passenger car lighting system and discuss the same. (14)

Or

18. How electric horn works? Explain with a neat sketch. How the tuning of horn is carried out? (14)

Module 5

19. Explain the working of MAP sensor and Throttle position sensor used in automobile with the help of sketch. (14)

Or

20. a) Explain about the application of position and lambda sensors used in automobile with neat sketches. (7)

b) Explain about the function of wheel speed sensors with neat sketch.

(7)

SYLLABUS

Module 1

Principle of lead acid battery & constructional details, Effect of temperature on electrolyte, Capacity Rating, Battery charging methods, Battery tests. Developments in storage: Nickel metal hydride battery, Lithium-ion battery, Fuel cells, Ultra capacitors.

Module 2

Charging system: Working and constructional details of Alternators (single and three phase), Rectification, voltage regulation, current regulation, Charging circuit for 3 phase alternators.

Starting system: Requirement of starter motor; Starter Motor types, construction and characteristics, Starter drive mechanisms, Starting circuit, Starter Switches.

Module 3

Battery coil and Magneto ignition system, Centrifugal and Vacuum advance mechanisms, Spark plugs, constructional details and types. Electronically assisted ignition system; Non-contact triggering devices - Fully electronic ignition System, Capacitive Discharge Ignition, Distributor-less ignition, Programmed ignition.

Electronic fuel injection system overview; D jetronic, K jetronic and L jetronic fuel injection; Injections schemes–Single point, Multi point, Sequential, Direct injection, Common rail direct injection, Gasoline direct injection, Supercritical injection.

Module 4

Lighting: Types of headlights, headlight reflectors, headlight lenses, indicator lamp details, lighting circuit, projector headlights; Horn and wiper mechanisms.

Instrumentation: Speedometer, Fuel Level Indicator, Oil Pressure and Coolant Temperature Indicators, Display devices – LED, LCD, VFD, Onboard diagnostics (OBD), OBD – II.

Module 5

Sensors and applications in Automobile: Pressure sensors, Temperature sensors, Position sensors, Lambda sensor, Air flow sensor, Wheel speed sensor, Knock sensor, Optical sensors. Actuators: Solenoids, Stepper motors, Relays, Piezoelectric. Introduction to internet of things (IOT) and its automotive applications.

Text Books

1. Kohli.P.L. Automotive Electrical Equipment, Tata McGraw-Hill Co Ltd
2. Tom Denton, “Automobile Electrical and Electronic Systems”, Elsevier Butterworth-Heinemann, 2004.

References

1. Al Santini, Automotive Electricity and Electronics, Cengage Learning, 2013

AUTOMOBILE ENGINEERING

2. Robert Bosch, Automotive Handbook, Bently Publishers, 2004
3. William B. Ribbens, Norman P. Mansour, Understanding automotive electronics, Newnes, 2003
4. Jim Horner, Automotive Electrical HandBook, Penguin, 1986
5. Barry Hollembeak, Automotive Electricity & Electronics, Cengage Learning, 2010

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Module 1 (9 hours)	
1.1	Principal of lead acid battery & constructional details	2
1.2	Effect of temperature on electrolyte	1
1.3	Capacity Rating; Battery Charging methods; Battery tests	1
1.4	Developments in storage: Nickel Metal hydride battery	2
1.5	Lithium-ion battery	1
1.6	Fuel cells; Ultracapacitors	2
2	Module 2 (9 hours)	
2.1	Charging system: Working and constructional details of Alternators (single and three phase)	1
2.2	Rectification; Voltage regulation; Charging circuit for 3 phase alternators	2
2.3	Starting system: Requirement of starter motor	1
2.4	Starter motors types, construction and characteristics	2
2.5	Starter drive mechanisms	2
2.6	Starting circuit, Starter switches	1
3	Module 3 (10 hours)	
3.1	Battery coil and Magneto ignition system	2
3.2	Centrifugal and vacuum advance mechanisms; Spark plugs, constructional details and types	1
3.3	Electronically assisted ignition system; Non-contact triggering devices – Fully electronic ignition system	1
3.4	Capacitive discharge ignition, Distributor – less ignition, Programmed	1

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	ignition	
3.5	Electronic fuel injection system overview; D jetronic, K jetronic and L jetronic fuel injection;	3
3.6	Injections schemes–Single point, Multi point, Sequential, Direct injection, Common rail direct injection, Gasoline direct injection, Supercritical injection	2
4	Module 4 (10 hours)	
4.1	Lighting: Types of headlights	1
4.2	Headlight reflectors, headlight lenses, indicator lamp details, lighting circuit,	2
4.3	Projector headlights; Horn and wiper mechanisms.	2
4.4	Instrumentation: Speedometer, Fuel Level Indicator, Oil Pressure and Coolant Temperature Indicators	2
4.5	Display devices – LED, LCD,VFD.	1
4.6	Onboard diagnostics (OBD), OBD – II	2
5	Module 5 (10 hours)	
5.1	Sensors and applications in Automobile: Pressure sensors,	2
5.2	Temperature sensors, Position sensors, Lambda sensor	2
5.3	Air flow sensor, Wheel speed sensor, Knock sensor, Optical sensors.	2
5.4	Actuators: Solenoids, Stepper motors, Relays, Piezoelectric	2
5.5	Introduction to internet of things (IOT) and its automotive applications	2

AUTOMOBILE ENGINEERING

AUT 306	AUTOMOTIVE COMPONENTS DESIGN	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: The aim of this subject is to offer the students a general understanding of various automotive components design.

- ✓ Explain concepts of mechanics of solids and fundamental approaches to failure prevention.
- ✓ To provide basic design methods for shafts, couplings and springs.
- ✓ To provide basic design methods for clutches, brakes and bearings.
- ✓ To provide basic design methods for gear.
- ✓ To provide basic design methods for internal combustion engine parts.
- ✓

Prerequisite:- MET 201: Mechanics of Solids

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the concepts of mechanics of solids and failure prevention of components.
CO 2	Apply the basic design methods for couplings, shafts and bearings.
CO 3	Apply the basic design methods for clutches, brakes and springs.
CO 4	Apply the basic design methods for gears.
CO 5	Apply the basic design methods for internal combustion engine parts.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	-	-	-	-	-	-	-	-	-
CO 2	1	-	3	-	-	-	-	-	-	-	-	-
CO 3	1	-	3	-	-	-	-	-	-	-	-	-
CO 4	1	-	3	-	-	-	-	-	-	-	-	-
CO 5	1	-	3	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand	10	10	20
Apply	40	40	80
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE (Continuous Internal Evaluation)	ESE (End Semester Examination)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Explain the concept of mechanics of solids.
2. Describe the fundamental approaches to failure prevention of components.

Course Outcome 2 (CO2)

1. Illustrate the basic design procedure for shafts.
2. Interpret the basic design procedure for couplings.
3. Extrapolate the basic design procedure of bearings.

Course Outcome 3(CO3):

1. Employ the basic design procedure of clutch.
2. Enumerate the basic design procedure for brakes.
3. Estimate the basic design procedure of springs.

Course Outcome 4 (CO4):

1. Illustrate the basic design procedure for gears.

Course Outcome 5 (CO5):

1. Demonstrate the basic design procedure of internal combustion engine parts.

Reg. No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT306

Course Name: AUTOMOTIVE COMPONENTS DESIGN

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. What are the different steps in design process?
2. Enumerate about the ductile and brittle properties of material?
3. Enumerate the flexible coupling with the help of neat sketch?
4. Illustrate the design considerations of shafts.
5. Explain about cone clutch with the help of neat sketch.
6. Discuss in detail about types of springs.
7. State and explain the law of gearing.
8. Comment about heat dissipation and lubrication of gears.
9. Explain about design procedure for piston.
10. Explain the design procedure of flywheel.

PART B

Answer any one full question from each module.

Each question carries 14 Marks.

Module 1

11. Suggest suitable materials for the following parts stating the special property which makes it more suitable for use in manufacturing: 1. Diesel engine crankshaft, 2. Automobile tyres, 3. Roller bearings 4. High pressure steam pipes 5. Stay bar of boilers 6. Worm and worm gear 7. Dies; 8. Tramway axle 9. Cam follower 10. Hydraulic brake piston.

(14)

Or

12. Explain in detail about,

a. Von Mises and Hencky Theory. (7)

b. St. Venant's Theory (7)

Module 2

13. A steel solid shaft transmitting 15 kW at 200 r.p.m. is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5 mm module is located 100 mm to the left of the right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5 mm module is located 150 mm to the right of the left hand bearing and receives power in a vertical direction from below. Using an allowable stress of 54 MPa in shear, determine the diameter of the shaft. (14)

Or

14. A shaft rotating at constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent radial load of 3 kN for 10 per cent of time, 2 kN for 20 per cent of time, 1 kN for 30 per cent of time and no load for remaining time of cycle. If the total life expected for the bearing is 20×10^6 revolutions at 95 per cent reliability, calculate dynamic load rating of the ball bearing. (14)

Module 3

15. A band brake acts on the circumference of a drum of 450 mm diameter which is keyed to the shaft. The band brake provides a braking torque of 225 N-m. One end of the band is attached to a fulcrum pin of the lever and the other end to a pin 100 mm from the fulcrum. If the operating force applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, find the operating force when the drum rotates in the anticlockwise direction. If the brake lever and pins are to be made of mild steel having permissible stresses for tension and crushing as 70 MPa and for shear 56 MPa, design the shaft, key, lever, and pins. The bearing pressure between the pin and the lever may be taken as 8 N/mm². (14)

Or

16. Design a helical spring for a spring-loaded safety valve (Ramsbottom safety valve) for the following conditions : Diameter of valve seat = 65 mm ; Operating pressure = 0.7 N/mm²; Maximum pressure when the valve blows off freely = 0.75 N/mm²; Maximum lift of the valve when the pressure rises from 0.7 to 0.75 N/mm² = 3.5 mm ; Maximum allowable stress = 550 MPa ; Modulus of rigidity = 84 kN/mm²; Spring index = 6. Draw a neat sketch of the free spring showing the main dimensions. (14)

Module 4

17. A bronze spur pinion rotating at 600 r.p.m. drives a cast iron spur gear at a transmission ratio of 4 : 1. The allowable static stresses for the bronze pinion and cast-iron gear are 84 MPa and 105 MPa, respectively. The pinion has 16 standard 20° full depth involute teeth of module 8 mm. The face width of both the gears is 90 mm. Find the power that can be transmitted from the standpoint of strength. (14)

Or

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18. A motor shaft rotating at 1500 r.p.m. has to transmit 15 kW to a low-speed shaft with a speed reduction of 3:1. The teeth are 14° involute with 25 teeth on the pinion. Both the pinion and gear are made of steel with a maximum safe stress of 200 MPa. A safe stress of 40 MPa may be taken for the shaft on which the gear is mounted and for the key. Design a spur gear drive to suit the above conditions. Also sketch the spur gear drive. Assume starting torque to be 25% higher than the running torque. (14)

Module 5

19. Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore = 100 mm ; Stroke = 125 mm ; Maximum gas pressure = 5 N/mm² ; Indicated mean effective pressure = 0.75 N/mm² ; Mechanical efficiency = 80% ; Fuel consumption = 0.15 kg per brake power per hour ; Higher calorific value of fuel = 42 × 10³ kJ/kg ; Speed = 2000 r.p.m. Any other data required for the design may be assumed (14)

Or

20. Design a side or overhung crankshaft for a 250 mm × 300 mm gas engine. The weight of the flywheel is 30 kN and the explosion pressure is 2.1 N/mm². The gas pressure at the maximum torque is 0.9 N/mm², when the crank angle is 35° from I. D. C. The connecting rod is 4.5 times the crank radius. (14)

SYLLABUS

Module 1

Introduction to Design- Definition, steps in design process, preferred numbers, standards and codes in design. Materials and their properties- Elastic and plastic behaviour of metals, ductile and brittle behaviour, shear, bending and torsional stresses, combined stresses, stress concentration factor.

Theories of Failure- Guest's Theory, Rankine's Theory, St. Venant's Theory, Haigh's Theory, and Von Mises and Hencky Theory. Shock and impact loads, fatigue loading, endurance limit stress, factors affecting endurance limit, factor of safety.

Module 2

Shafting- material, design considerations, causes of failure in shafts, design based on strength, rigidity and critical speed, design for static and fatigue loads, repeated loading, reversed bending. Design of Coupling- selection, classification, rigid and flexible coupling, design of keys and pins. Rolling contact bearing- Design of bearings, Types, Selection of a bearing type, bearing life, static and dynamic load capacity, axial and radial loads, selection of bearings, dynamic equivalent load. Sliding contact bearing- lubrication, lubricants, viscosity, Journal bearings, hydrodynamic theory, Sommerfield number, design considerations.

Module 3

Clutches – friction clutches, design considerations, multiple disc clutches, cone clutch, centrifugal clutch. Brakes - Block brakes, band brake, Internal expanding shoe brake. Springs- classification, spring materials, stresses and deflection of helical springs, axial loading, curvature effect, resilience,

AUTOMOBILE ENGINEERING

static and fatigue loading, surging, critical frequency, end construction. Leaf springs- Flat springs, semi elliptical laminated leaf springs, design of leaf springs.

Module 4

Gears- classification, Gear nomenclature, Tooth profiles, Materials of gears, Law of gearing (review only), virtual or formative number of teeth, gear tooth failures, Beam strength, Lewis equation, Buckingham's equation for dynamic load, wear load, endurance strength of tooth, surface durability, heat dissipation – lubrication of gears – Merits and demerits of each type of gears. Design of spur gear and helical gear.

Module 5

Design of Internal combustion engine parts- Piston, Cylinder, Connecting rod and Flywheel.

Textbooks

1	V.B.Bhandari	Design of Machine elements	McGraw Hill, 2016
2	R.S.Khurmi,J.K.Gupta	Machine Design	Eurasia Publishing House,2005
3	R. L. Norton	Machine Design – An Integrated Approach	Pearson Education, 2001

Reference Books

1	Rajendra Karwa	Machine Design	Laxmi Publications (P) LTD, New Delhi, 2006
2	J. E. Shigley	Mechanical Engineering Design	McGraw Hill book company
3	Juvinall R.C & Marshek K.M.	Fundamentals of Machine Component Design	John Wiley,2011

Databook

1	K. Mahadevan, K.Balaveera Reddy	Design Data Handbook	CBS Publishers & Distributors, 2013
2	Narayana Iyengar B.R & Lingaiah K	Machine Design Data Handbook,	Tata McGraw Hill, 1984
3	PSG Design Data	Design Data Handbook	DPV Printers,Coimbatore,2012

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Module 1 (9 hours)	
1.1	Introduction to Design- Definition, steps in design process, preferred numbers, standards and codes in design.	2
1.2	Materials and their properties- Elastic and plastic behaviour of metals, ductile and brittle behaviour.	2
1.3	Shear, bending and torsional stresses, combined stresses, stress concentration factor.	2
1.4	Theories of Failure- Guest's Theory, Rankine's Theory, St. Venant's Theory, Haigh's Theory, and Von Mises and Hencky Theory.	2
1.5	Shock and impact loads, fatigue loading, endurance limit stress, factors affecting endurance limit, factor of safety.	1
2	Module 2 (10 hours)	
2.1	Shafting- material, design considerations, causes of failure in shafts, design based on strength, rigidity and critical speed.	2
2.2	Design for static and fatigue loads, repeated loading, reversed bending.	1
2.3	Design of Coupling- selection, classification, rigid and flexible coupling, design of keys and pins.	2
2.4	Rolling contact bearing- Design of bearings, Types, Selection of a bearing type, bearing life, static and dynamic load capacity, axial and radial loads, selection of bearings, dynamic equivalent load.	3
2.5	Sliding contact bearing- lubrication, lubricants, viscosity, Journal bearings, hydrodynamic theory, Sommerfield number, design considerations.	2
3	Module 3 (10 hours)	
3.1	Clutches – friction clutches, design considerations.	1
3.2	Multiple disc clutches, cone clutch, centrifugal clutch.	2
3.3	Brakes - Block brakes, band brake, Internal expanding shoe brake.	2
3.4	Springs- classification, spring materials, stresses and deflection of helical springs, axial loading.	2
3.5	Curvature effect, resilience, static and fatigue loading, surging, critical	1

AUTOMOBILE ENGINEERING

	frequency, end construction.	
3.6	Leaf springs- Flat springs, semi elliptical laminated leaf springs, design of leaf springs.	2
4	Module 4 (10hours)	
4.1	Gears- classification, Gear nomenclature, Tooth profiles, Materials of gears, Law of gearing (review only).	2
4.2	Virtual or formative number of teeth, gear tooth failures, Beam strength.	2
4.3	Lewis equation, Buckingham's equation for dynamic load, wear load, endurance strength of tooth, surface durability, heat dissipation.	2
4.4	Lubrication of gears – Merits and demerits of each type of gears.	2
4.5	Design of spur gear and helical gear.	2
5	Module 5 (9 hours)	
5.1	Design of Internal combustion engine parts- Piston.	2
5.2	Design of Internal combustion engine parts-Cylinder.	2
5.3	Design of Internal combustion engine parts- Connecting rod.	2
5.4	Design of Internal combustion engine parts- Flywheel.	3

HUT 300	Industrial Economics & Foreign Trade	Category	L	T	P	CREDIT
		HSMC	3	0	0	3

Preamble: To equip the students to take industrial decisions and to create awareness of economic environment.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the problem of scarcity of resources and consumer behaviour, and to evaluate the impact of government policies on the general economic welfare. (Cognitive knowledge level: Understand)
CO2	Take appropriate decisions regarding volume of output and to evaluate the social cost of production. (Cognitive knowledge level: Apply)
CO3	Determine the functional requirement of a firm under various competitive conditions. (Cognitive knowledge level: Analyse)
CO4	Examine the overall performance of the economy, and the regulation of economic fluctuations and its impact on various sections in the society. (Cognitive knowledge level: Analyse)
CO5	Determine the impact of changes in global economic policies on the business opportunities of a firm. (Cognitive knowledge level: Analyse)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2										3	
CO2	2	2			2	2	3				3	
CO3	2	2	1								3	
CO4	2	2	1			1					3	
CO5	2	2	1								3	

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	20	20	40
Apply	15	15	30

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment - Test (2 numbers)	: 25 marks
Continuous Assessment - Assignment	: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B.

Part A	: 30 marks
Part B	: 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 3 sub-divisions and carries 14 marks.

SYLLABUS

HUT 300 Industrial Economics & Foreign Trade

Module 1 (Basic Concepts and Demand and Supply Analysis)

Scarcity and choice - Basic economic problems- PPC – Firms and its objectives – types of firms – Utility – Law of diminishing marginal utility – Demand and its determinants – law of demand – elasticity of demand – measurement of elasticity and its applications – Supply, law of supply and determinants of supply – Equilibrium – Changes in demand and supply and its effects – Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.

Module 2 (Production and cost)

Production function – law of variable proportion – economies of scale – internal and external economies – Isoquants, isocost line and producer's equilibrium – Expansion path – Technical progress and its implications – Cobb-Douglas production function - Cost concepts – Social cost: private cost and external cost – Explicit and implicit cost – sunk cost - Short run cost curves - long run cost curves – Revenue (concepts) – Shutdown point – Break-even point.

Module 3 (Market Structure)

Perfect and imperfect competition – monopoly, regulation of monopoly, monopolistic competition (features and equilibrium of a firm) – oligopoly – Kinked demand curve – Collusive oligopoly (meaning) – Non-price competition – Product pricing – Cost plus pricing – Target return pricing – Penetration pricing – Predatory pricing – Going rate pricing – Price skimming.

Module 4 (Macroeconomic concepts)

Circular flow of economic activities – Stock and flow – Final goods and intermediate goods - Gross Domestic Product - National Income – Three sectors of an economy- Methods of measuring national income – Inflation- causes and effects – Measures to control inflation- Monetary and fiscal policies – Business financing- Bonds and shares -Money market and Capital market – Stock market – Demat account and Trading account - SENSEX and NIFTY.

Module 5 (International Trade)

Advantages and disadvantages of international trade - Absolute and Comparative advantage theory - Heckscher - Ohlin theory - Balance of payments – Components – Balance of Payments

deficit and devaluation – Trade policy – Free trade versus protection – Tariff and non-tariff barriers.

Reference Materials

1. Gregory N Mankiw, 'Principles of Micro Economics', Cengage Publications
2. Gregory N Mankiw, 'Principles of Macro Economics', Cengage Publications
3. Dwivedi D N, 'Macro Economics', Tata McGraw Hill, New Delhi.
4. Mithani D M, 'Managerial Economics', Himalaya Publishing House, Mumbai.
5. Francis Cherunilam, 'International Economics', McGraw Hill, New Delhi.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Why does the problem of choice arise?
2. What are the central problems?
3. How do we solve the basic economic problems?
4. What is the relation between price and demand?
5. Explain deadweight loss due to the imposition of a tax.

Course Outcome 2 (CO2):

1. What is shutdown point?
2. What do you mean by producer equilibrium?
3. Explain break-even point;
4. Suppose a chemical factory is functioning in a residential area. What are the external costs?

Course Outcome 3 (CO3):

1. Explain the equilibrium of a firm under monopolistic competition.
2. Why is a monopolist called price maker?
3. What are the methods of non-price competition under oligopoly?

4. What is collusive oligopoly?

Course Outcome 4 (CO4):

1. What is the significance of national income estimation?
2. How is GDP estimated?
3. What are the measures to control inflation?
4. How does inflation affect fixed income group and wage earners?

Course Outcome 5 (CO5):

1. What is devaluation?
2. Suppose a foreign country imposes a tariff on Indian goods. How does it affect India's exports?
3. What is free trade?
4. What are the arguments in favour of protection?

Model Question paper

QP CODE:

PAGES:3

Reg No:_____

Name :_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIFTH /SIXTH SEMESTER
B.TECH DEGREE EXAMINATION, MONTH & YEAR**

Course Code: HUT 300

Course Name: Industrial Economics & Foreign Trade

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Why does an economic problem arise?
2. What should be the percentage change in price of a product if the sale is to be increased by 50 percent and its price elasticity of demand is 2?
3. In the production function $Q = 2L^{1/2}K^{1/2}$ if $L=36$ how many units of capital are needed to produce 60 units of output?
4. Suppose in the short run $AVC < P < AC$. Will this firm produce or shut down? Give reason.
5. What is predatory pricing?
6. What do you mean by non- price competition under oligopoly?
7. What are the important economic activities under primary sector?
8. Distinguish between a bond and share?
9. What are the major components of balance of payments?

10. What is devaluation?

(10 x 3 = 30 marks)

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Prepare a utility schedule showing units of consumption, total utility and marginal utility, and explain the law of diminishing marginal utility. Point out any three limitations of the law.
- b) How is elasticity of demand measured according to the percentage method? How is the measurement of elasticity of demand useful for the government?

Or

12. a) Explain the concepts consumer surplus and producer surplus.
- b) Suppose the government imposes a tax on a commodity where the tax burden met by the consumers. Draw a diagram and explain dead weight loss. Mark consumer surplus, producer surplus, tax revenue and dead weight loss in the diagram.

MODULE II

13. a) What are the advantages of large-scale production?
- b) Explain Producer equilibrium with the help of isoquants and isocost line. What is expansion path?

Or

14. a) Explain break-even analysis with the help of a diagram.
- b) Suppose the monthly fixed cost of a firm is Rs. 40000 and its monthly total variable cost is Rs. 60000.
- If the monthly sales is Rs. 120000 estimate contribution and break-even sales.
 - If the firm wants to get a monthly profit of Rs.40000, what should be the sales?
- c) The total cost function of a firm is given as $TC=100+50Q - 11Q^2+Q^3$. Find marginal cost when output equals 5 units.

MODULE III

15. a) What are the features of monopolistic competition?

b) Explain the equilibrium of a firm earning supernormal profit under monopolistic competition.

Or

16.a) Make comparison between perfect competition and monopoly.

b) Explain price rigidity under oligopoly with the help of a kinked demand curve.

MODULE IV

17. a) How is national income estimated under product method and expenditure method?

b) Estimate GDPmp, GNPmp and National income

Private consumption expenditure	= 2000 (in 000 cores)
Government Consumption	= 500
NFIA	= -(300)
Investment	= 800
Net=exports	=700
Depreciation	= 400
Net-indirect tax	= 300

Or

18. a) What are the monetary and fiscal policy measures to control inflation?

b) What is SENSEX?

MODULE V

19. a) What are the advantages of disadvantages of foreign trade?

b) Explain the comparative cost advantage.

Or

20. a) What are the arguments in favour protection?

b) Examine the tariff and non-tariff barriers to international trade.

(5 × 14 = 70 marks)

Teaching Plan

Module 1 (Basic concepts and Demand and Supply Analysis)		7 Hours
1.1	Scarcity and choice – Basic economic problems - PPC	1 Hour
1.2	Firms and its objectives – types of firms	1 Hour
1.3	Utility – Law of diminishing marginal utility – Demand – law of demand	1 Hour
1.4	Measurement of elasticity and its applications	1 Hour
1.5	Supply, law of supply and determinants of supply	1 Hour
1.6	Equilibrium – changes in demand and supply and its effects	1 Hour
1.7	Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.	1 Hour
Module 2 (Production and cost)		7 Hours
2.1	Productions function – law of variable proportion	1 Hour
2.2	Economies of scale – internal and external economies	1 Hour
2.3	producers equilibrium – Expansion path	1 Hour
2.4	Technical progress and its implications – cob Douglas Production function	1 Hour
2.5	Cost concepts – social cost: private cost and external cost – Explicit and implicit cost – sunk cost	1 Hour
2.6	Short run cost curves & Long run cost curves	1 Hour
2.7	Revenue (concepts) – shutdown point – Break-even point.	1 Hour
Module 3 (Market Structure)		6 hours
3.1	Equilibrium of a firm, MC – MR approach and TC – TR approach	1 Hour
3.2	Perfect competition & Imperfect competition	1 Hour
3.3	Monopoly – Regulation of monopoly – Monopolistic competition	1 Hour
3.4	Oligopoly – kinked demand curve	1 Hour
3.5	Collusive oligopoly (meaning) – Non price competition	1 Hour
3.6	Cost plus pricing – Target return pricing – Penetration, Predatory pricing – Going rate pricing – price skimming	1 Hour

Module 4 (Macroeconomic concepts)		7 Hours
4.1	Circular flow of economic activities	1 Hour
4.2	Stock and flow – Final goods and intermediate goods – Gross Domestic Product - National income – Three sectors of an economy	1 Hour
4.3	Methods of measuring national income	1 Hour
4.4	Inflation – Demand pull and cost push – Causes and effects	1 Hour
4.5	Measures to control inflation – Monetary and fiscal policies	1 Hour
4.6	Business financing – Bonds and shares – Money market and capital market	1 Hour
4.7	Stock market – Demat account and Trading account – SENSEX and NIFTY	1 Hour
Module 5 (International Trade)		8 Hours
5.1	Advantages and disadvantages of international trade	1 Hour
5.2	Absolute and comparative advantage theory	2 Hour
5.3	Heckscher – Ohlin theory	1 Hour
5.4	Balance of payments - components	1 Hour
5.5	Balance of payments deficit and devaluation	1 Hour
5.6	Trade policy – Free trade versus protection	1 Hour
5.7	Tariff and non tariff barriers.	1 Hour

AUTOMOBILE ENGINEERING

AUT 308	COMPREHENSIVE COURSE WORK	CATEGORY	L	T	P	CREDIT
		PCC	1	0	0	1

Preamble: The aim of this subject is to evaluate the overall understanding of the students in the core areas of Automobile Engineering

Engineering Programme.

- ✓ To assess the comprehensive knowledge gained in basic courses relevant to the branch of study
- ✓ To comprehend the questions asked and answer them with confidence.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	The students will be confident in discussing the fundamental aspects of any engineering problem/situation and give answers in dealing with them.
-------------	--

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									

Assessment Pattern

Bloom's Category	Viva	End Semester Examination
		MCQ
Remember	20	25
Understand	20	25
Apply		
Analyse		
Evaluate		
Create		

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	1 hour

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Viva : 40 marks

AUTOMOBILE ENGINEERING

End Semester Examination Pattern: 50 Multiple Choice Questions will be asked, each carrying one mark.

10 Questions from each core subjects (5 subjects mentioned in syllabus)

Course Level Assessment Questions

Course Outcome 1 (CO1):

- The students will be confident in discussing the fundamental aspects of any engineering problem/ situation and give answers in dealing with them.

SYLLABUS

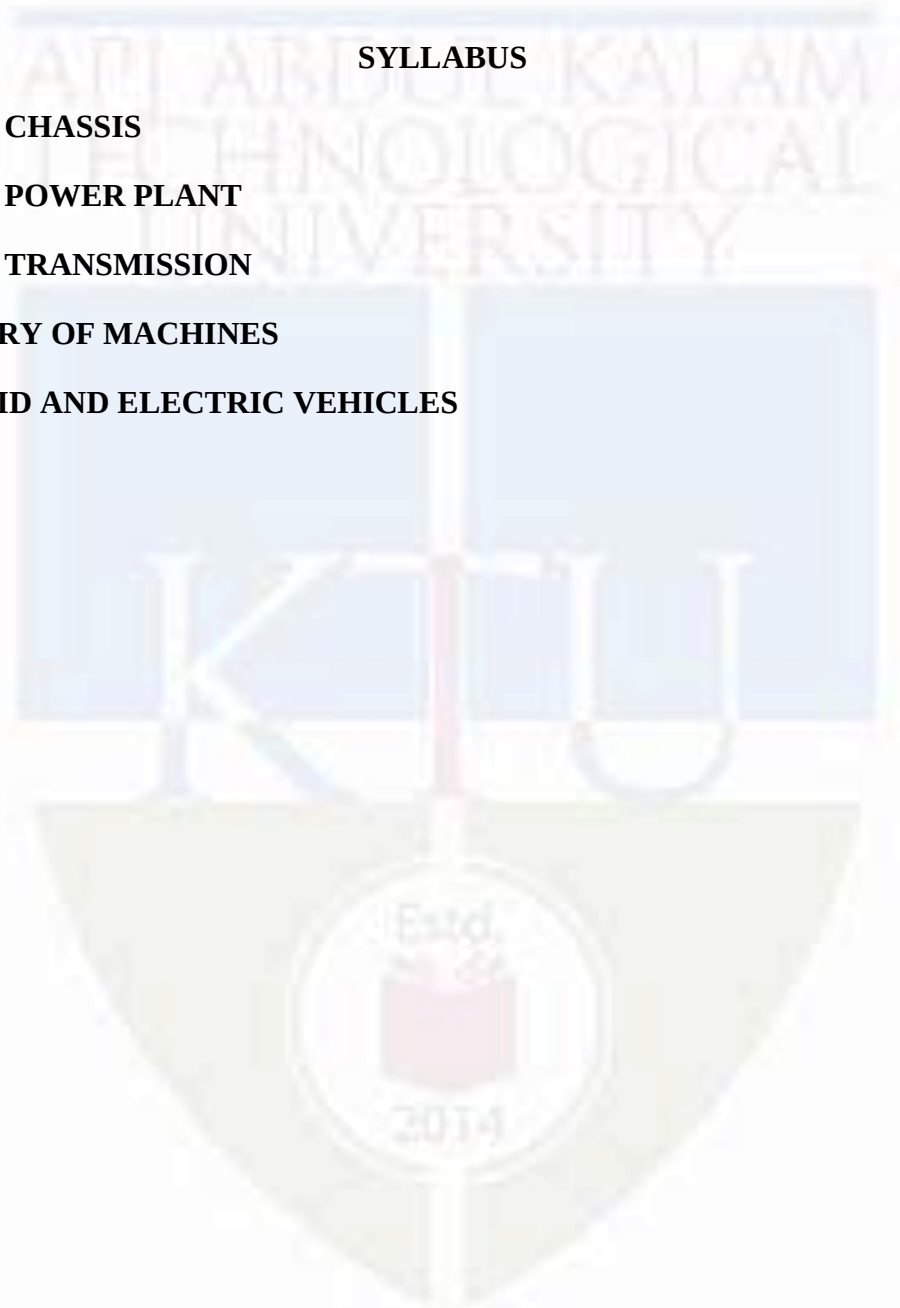
AUT201 AUTO CHASSIS

AUT204 AUTO POWER PLANT

AUT206 AUTO TRANSMISSION

AUT301 THEORY OF MACHINES

AUT305 HYBRID AND ELECTRIC VEHICLES



AUTOMOBILE ENGINEERING

MEL332	COMPUTER AIDED DESIGN AND ANALYSIS LAB	CATEGORY	L	T	P	CREDITS
		PCC	0	0	3	2

Preamble:

- To introduce students to the basics and standards of engineering design and analysis related to machine components.
- To make students familiarize with different solid modelling and analysis soft wares
- To convey the principles and requirements of modelling and analysis of machine elements.
- To introduce the preparation of part modelling and assembly modelling of machineries
- To introduce standard CAD packages to perform Finite Element Analysis of machine parts

Prerequisite:

EST 110 - Engineering Graphics

MEL 201 - Computer Aided Machine Drawing

Course Outcomes - At the end of the course students will be able to

CO1	Gain working knowledge in Computer Aided Design and modelling procedures.
CO2	Gain knowledge in creating solid machinery parts.
CO3	Gain knowledge in assembling machine elements.
CO4	Gain working knowledge in Finite Element Analysis.
CO5	Solve simple structural, heat and fluid flow problems using standard software

Mapping of course outcomes with program outcomes (Minimum requirements)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	2	-	-
CO2	3	-	1	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	2	2	-	-
CO4	3	1	3	-	-	-	-	1	2	3	-	-
CO5	3	3	2	-	-	-	-	2	3	3	-	-

Mark Distribution

Total Marks	CIE Marks	ESE marks	ESE duration
150	75	75	2.5 hours

Continuous Internal Evaluation (CIE) Pattern:

Attendance	15 marks
Regular class work/Modelling and Analysis/Lab Record and Class Performance	30 marks
Continuous Assessment Test (minimum two tests)	30 marks

Continuous Assessment test pattern

Bloom's Taxonomy	Continuous Assessment Tests	
	Test 1 - PART A MODELLING (marks)	Test 2 - PART B ANALYSIS (marks)
Remember	10	10
Understand	10	10
Apply	20	20
Analyse	15	15
Evaluate	20	20
Create	25	25

End semester examination pattern

End semester examination shall be conducted on modelling and analysis and based on complete syllabus. The following general guidelines should be maintained for the award of marks

- Part A Assembly Modelling – 35 marks
- Part B Analysis – 30 marks
- Viva Voce – 10 marks.

Conduct of University Practical Examinations

The Principals of the concerned Engineering Colleges with the help of the Chairmen/Chairperson will conduct the practical examination with the approval from the University and bonafide work / laboratory record, hall ticket, identity card issued by college are mandatory for appearing practical University examinations. No practical examination should be conducted without the presence of an external examiner appointed by the University.

References Books:

1. Daryl Logan, A First course in Finite Element Method, Thomson Learning, 2007
2. David V Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill, 2003
3. Ibrahim Zeid, CAD/ CAM Theory and Practice, McGraw Hill, 2007
4. Mikell P. Groover and Emory W. Zimmer, CAD/ CAM – Computer aided design and manufacturing, Pearson Education, 1987
5. T. R. Chandrupatla and A. D. Belagundu, Introduction to Finite Elements in Engineering, Pearson Education, 2012

AUTOMOBILE ENGINEERING

Experiment List (Minimum 12 exercises)

SL.NO	PART - A (Minimum 6 models)	COURSE OUTCOMES	HOURS
1	Creation of high end part models (minimum 2 models, Questions for examinations must not be taken from this portions)	CO1, CO2	6
2	Creating assembly models of Socket and spigot joint, Knuckle Joint, Rigid flange couplings, Bushed Pin flexible coupling, Plummer block, Single plate clutch and Cone friction clutch. Pipe joints, Screw jack, Tail stock etc. (minimum 4 models)	CO1, CO2, CO3	12
	PART – B (Minimum 6 problems)		
3	Structural analysis. (minimum 3 problems)	CO4, CO5	6
4	Thermal analysis. (minimum 2 problems)	CO4, CO5	3
5	Fluid flow analysis. (minimum 1 problem)	CO4, CO5	3

END SEMSTER EXAMINATION
MODEL QUESTION PAPER

Duration : 2.5 hours

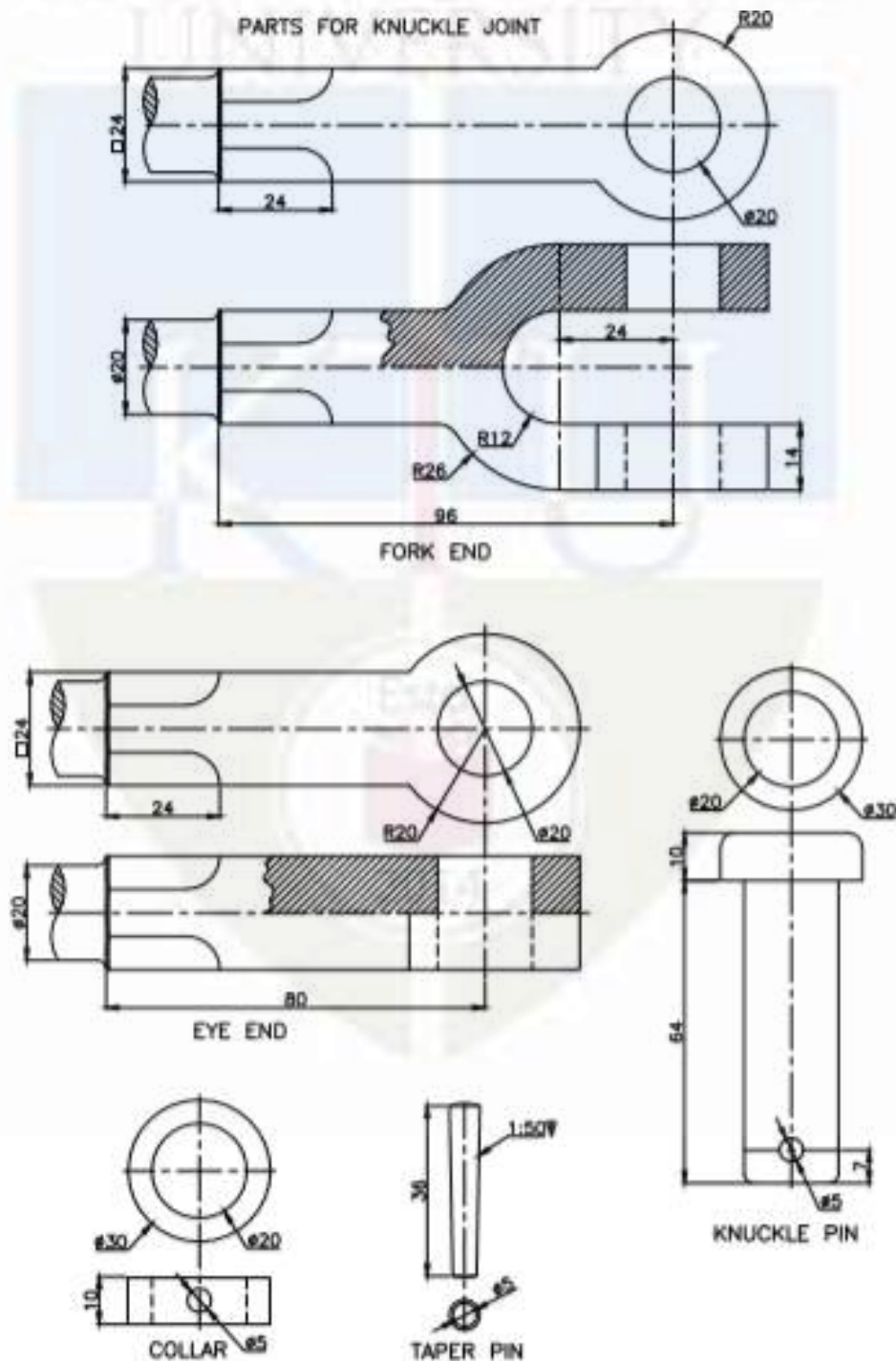
Marks : 75

Note :

1. All dimensions in mm
2. Assume missing dimensions appropriately
3. A4 size answer booklet shall be supplied
4. Viva Voce shall be conducted for 10 marks

PART A (ASSEMBLY MODELLING) – 35 marks

1. Create an assembly model using the part details given below



PART B (FINITE ELEMENT ANALYSIS) – 30 marks

2. Air flows over a long cylinder of 150mm diameter at a velocity of 3m/sec at a temperature of 105° F. Using this data and applying finite element technique find
- Max velocity
 - Plot flow trajectories
 - Cut plot of velocity



AUTOMOBILE ENGINEERING

CODE AUL334	COURSE NAME AUTOMOBILE LAB III	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble:

This lab is mainly focussed to develop a platform where the students can enhance their engineering knowledge in various electrical components, testing and their application in automobiles by applying their theoretical knowledge acquired.

Prerequisite: Nil

Course Outcomes:

After the completion of the course the student will be able to

CO 1	To study about hand tools, special purpose tools, and their uses.
CO 2	To familiarize with various electrical systems and components of an automobile.
CO 3	To know about technical specifications and description of electrical components.
CO 4	To know about applications of electrical components of automobiles.
CO 5	To test various electrical components of automobiles.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1						2	3	2		2
CO 2	2	1						2	3	2		2
CO 3	2	1						2	3	2		2
CO 4	2	1						2	3	2		2
CO 5	2	1						2	3	2		2

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation Pattern (CIE):

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

AUTOMOBILE ENGINEERING

End Semester Examination (ESE) Pattern: The following guidelines should be followed regarding award of marks,

- | | |
|--|------------|
| (a) Preliminary work | : 15 Marks |
| (b) Implementing the work/Conducting the experiment | : 10 Marks |
| (c) Performance, result and inference (usage of equipment's and troubleshooting) | : 25 Marks |
| (d) Viva voce | : 20 marks |
| (e) Record | : 5 Marks |

General instructions:

Practical examination to be conducted after the second series test covering minimum 12 exercises/experiments given below. End Semester Examination Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

AUL 334: AUTOMOBILE LAB III

SYLLABUS

LIST OF EXPERIMENTS

Study

1. Study of hand tools, special purpose tools and its uses
2. Study of brushless permanent magnet motors in electric vehicles.
3. Belt tension checking of alternator.

List of Exercises/Experiments

1. Testing of automobile battery
2. Servicing of advanced ignition system.
3. Testing of regulators and cut - outs of Electric vehicles.
4. Servicing and testing of starter motor.
5. Servicing of alternator.
6. Testing of alternator.
7. Focussing on an automobile headlight.
8. Fault detection testing in wiring harness.
9. Servicing and Testing of hybrid vehicle systems.
10. Servicing and Testing of electric two-wheeler systems.
11. Servicing and Testing of electric regenerative systems.
12. Servicing and Testing of Electric four-wheeler Systems
13. On Board Diagnosis of electrical systems.
14. General maintenance of Electric and Hybrid vehicles.

Reference Books

1. Automobile Engineering , Vol 1 , Dr Kripal Singh , Standard Publishers distributors.
2. Automobile Engineering , Vol 2 , Dr Kripal Singh , Standard Publishers distributors.
3. Automobile Engineering Practical, N Malhotra , Asian Publishers.
4. Vehicle service manuals of reputed manufacturers.
5. Automotive Mechanics , William H Crouse Donald L Anglin, Tata McGraw HillPublishing.
6. Automotive Handbook, Robert Bosch,10th edition, John Wiley and sons limited.
7. Automotive Electrical and Electronics, A K Babu, 2nd edition, Khanna publishing company Pvt.Ltd.



APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER VI

PROGRAM ELECTIVE I



AUTOMOBILE ENGINEERING

AUT312	TWO AND THREE WHEELED VEHICLE	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: The aim of this subject is to make the students acquire knowledge about the Two and three wheeler vehicles and make them understand the working of various components and its features.

Prerequisite: Auto power plant, Automotive Transmission, Automotive Electrical and Electronics

Course Outcomes: At the end of course, students should be able to

CO 1	Understand the Two and Three wheeled vehicles frames & its components
CO 2	Understand the fuel, lubrication and electrical systems used in two and three wheel vehicles
CO 3	Acquire knowledge on transmission and steering system
CO 4	Illustrate the brakes and suspension system
CO 5	Understand the criteria used for performance and maintenance

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	-	-	-	-	-	-	2	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Explain the types of two and three wheelers
2. Explain the types of frames used in two wheelers
3. Explain the main components used in Three wheelers

Course Outcome 2 (CO2)

1. Explain the constructional details of fuel system
2. Explain the constructional details of lubrication and cooling system
3. Explain the layout of electrical wiring of a two wheeler

Course Outcome 3(CO3):

1. Explain the working of clutches and its types?
2. List out and explain the types of transmission system used in two wheeler
3. Explain the constructional details of steering system?

Course Outcome 4 (CO4):

1. Explain the types of brakes systems?
2. Explain the constructional details of suspension systems?

Course Outcome 5 (CO5):

1. Explain the factors affecting fuel economy and emission?
2. Explain the handling characteristics of racing bikes?

Model Question paper

QP CODE:

PAGES:2

Reg. No:_____

Name :_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT312

Course Name: TWO AND THREE WHEELED VEHICLE

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. List out and explain the types of two wheelers?
2. Explain the main components used in a three wheeler?
3. Explain the layout of fuel supply system?
4. Explain the construction of a spark plug with a neat sketch
5. Explain the term rake angle and trail
6. Write a short note on final drive used in a three wheeler
7. Explain the types of suspension system used in a two wheeler
8. Explain the merits and demerits of Disc brakes system
9. Explain the factors affecting fuel economy and emission
10. Explain the safety arrangements in a two wheeler

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

AUTOMOBILE ENGINEERING

11. Explain the different types of frames used in a two wheeler with a neat sketch (14)
- Or
12. Explain the types of three wheelers and its features (14)

Module 2

13. Explain the wiring of a two wheeler with a neat sketch (14)
- Or
14. Briefly explain the different types of Cooling system used in a three wheeler. (14)

Module 3

15. Describe the types of clutches used in two wheeler (14)
- Or
16. Explain the Constructional details of continuous variable transmission system (14)

Module 4

17. Briefly explain the types of wheels and also explain the loads acting on frame (14)
- Or
18. Explain the Constructional details of a telescopic shock absorber (14)

Module 5

19. Briefly explain the ergonomic factors considered for a two wheeler (14)
- Or
20. Explain the method of breakdown maintenance of two wheeler (14)

SYLLABUS

Module 1

INTRODUCTION: TWO WHEELERS: Types – Standard class, Touring class, sports bikes, cruiser class, Off-road class. Frames & Body: Types of Frames – tubular steel frame, diamond, cradle, backbone, underbone, trellis frame.

THREE WHEELERS: types – Passenger carrier, goods carriers and its features, Main components used in three wheelers

AUTOMOBILE ENGINEERING

Materials used for frames, RTO Regulations, Aerodynamic and Ergonomic consideration of body work, side car

Module 2

FUEL, LUBRICATION & COOLING SYSTEM: layout of fuel supply system, Construction and working of a fuel system, Types of cooling systems, advantages of air cooling system, Lubrication types, Lubrication of parts and grades of lubrication oil.

ELECTRICAL SYSTEM:Types of ignition system, working principles, wiring diagram of a two wheeler, spark plug construction, indicators and gauges used in two wheelers, lighting system

Module 3

TRANSMISSION SYSTEMS: Clutch – special requirements, Slipper Clutch, different types used in two & three wheelers, need for primary reduction, Selection of transmission system – gear transmission, gear shift mechanism, belt transmission, Continuous variable transmission, Final drive & differential for three wheelers wheel drive arrangement.

STEERING SYSTEM:Steering geometry, steering column construction, Rake angle and trail, steering system for three wheelers, panel meters and controls on handle bar.

Module 4

BRAKES & WHEELS: Front and rear braking system, disc and drum brakes, its merits and demerits, Types of wheels, Loads acting on wheels, Construction and materials of wheels, Wheels and tyre designation, types of tyres, Constructional details. ABS for two wheelers, Single channel & Dual Channel

SUSPENSION SYSTEM: Front and rear suspension systems, shock absorber construction and working.

Module 5

ROAD PERFORMANCE: Handling characteristics, Driver and pillion seat arrangements, ergonomics & Comfort, road holding, Riding characteristics, Safety arrangements, Racing bikes – special requirements.

MAINTENANCE: Preventive and Break down maintenance, Factors affecting Fuel economy and emission. Case study of sports bike, Auto rickshaws, Pick up van, delivery van and trailers, recent developments

Text Books

1	Motor cycle Engineering	Irving P E	Temple press book, London
2	Two & three wheelers technology	Dhruv U Panchal	PHI

Reference Books

1	Automobile Mechanics	N K Giri Khanna Publishers
2	Two Wheelers	K K Ramalingam SciTech Publications
3	The cycle Motor Manual	Temple press Ltd., London, 1990
4	A Practical Guide to maintenance & repair	Raymond Broad lambretta,1987

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Introduction Module 1 (7 hours)	
1.1	Two Wheelers - Types – Standard class, Touring class, sports bikes, cruiser class, Off-road class.	1
1.2	Frames & Body: Types of Frames – tubular steel frame, diamond, cradle, backbone, underbone, trellis frame.	2
1.3	Three Wheelers - types – Passenger carrier, goods carriers and its features, Main components used in three wheelers	2
1.4	Materials used for frames, RTO Regulations,	1
1.5	Aerodynamic and Ergonomic consideration of body work, side car	1
2	Module 2 (7 hours)	
2.1	layout of fuel supply system, Construction and working of a fuel system,	1
2.2	Types of cooling systems, advantages of air cooling system	1
2.3	Lubrication types, Lubrication of parts and grades of lubrication oil.	1
2.4	Types of ignition system, working principles	2
2.5	wiring diagram of a two wheeler, spark plug construction, indicators and gauges used in two wheelers, lighting system	2
3	Module 3 (7 hours)	
3.1	Clutch – special requirements, Slipper Clutch, different types used in two & three wheelers	2
3.2	need for primary reduction, Selection of transmission system – gear transmission, gear shift mechanism, belt transmission, Continuous	2

AUTOMOBILE ENGINEERING

	variable transmission,	
3.3	Final drive & differential for three wheelers wheel drive arrangement.	1
3.4	Steering geometry, steering column construction, Rake angle and trail, steering system for three wheelers	1
3.5	Panel meters and controls on handle bar.	1
4	Module 4 (8hours)	
4.1	Front and rear braking system, disc and drum brakes, its merits and demerits, Types of wheels	2
4.2	Loads acting on wheels, Construction and materials of wheels, Wheels and tyre designation, types of tyres, Constructional details.	3
4.3	SUSPENSION SYSTEM: Front and rear suspension systems, shock absorber construction and working.	2
4.4	ABS for two wheelers, Single channel & Dual Channel	1
5	Module 5 (7 hours)	
5.1	Handling characteristics, Driver and pillion seat arrangements, ergonomics & Comfort, road holding	2
5.2	Riding characteristics, Safety arrangements, Racing bikes – special requirements.	1
5.3	Preventive and Break down maintenance, Factors affecting Fuel economy and emission.	2
5.4	Case study of sports bike, Auto rickshaws, Pick up van, delivery van and trailers, recent developments	2

AUT322	NUMERICAL METHODS	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

- ✓ To introduce the basic concepts of solving algebraic and transcendental equations
- ✓ To introduce the numerical techniques of interpolation in various intervals in real life situations
- ✓ To acquaint the student with understanding of numerical techniques of differentiation and integration
- ✓ To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- ✓ To understand the knowledge of various techniques and methods of solving various types of partial differential equations

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand concepts of solving algebraic and transcendental equations
CO 2	Discuss the numerical techniques of interpolation in various intervals in real life situations
CO 3	Acquaint the student with understanding of numerical techniques of differentiation and integration
CO 4	Acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
CO 5	Understand the various techniques and methods of solving various types of partial differential equations

[illegible]

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Explain the basic concepts of solving algebraic and transcendental equations

Course Outcome 2 (CO2)

1. Explain the numerical techniques of interpolation in various intervals in real life situations

Course Outcome 3(CO3):

- 1.Explain the numerical techniques of differentiation and integration

Course Outcome 4 (CO4):

- 1.Explain the knowledge of various techniques and methods of solving ordinary differential equations.

Course Outcome 5 (CO5):

1. Discuss the various techniques and methods of solving various types of partial differential equations.

Model Question paper

QP CODE:

PAGES:3

Reg. No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT 322

Course Name: NUMERICAL METHODS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. State Newton's formula for interpolation
2. What are Eigen values? Explain.
3. State Lagrange's interpolation formula for unequal intervals.
4. What do you mean by inverse interpolation?
5. Write down the formula for the cubic spline polynomial $y(x)$.
6. State Simpson's $1/3$ rule.
7. Explain Taylor's series method.
8. Brief on Milnes and Adam's method.
9. Find the divided differences of $f(x)=x^3-x^2+3x+8$ for the arguments 0,1,4,5.
10. Explain one dimensional heat flow equation by implicit methods.

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

AUTOMOBILE ENGINEERING

11. Explain the Fixed point iteration method to determine solution of algebraic and transcendental equations

Or

12. Explain the Gauss Jacobi iterative method in detail.

Module 2

13. Using Lagrange's interpolation formula, find $y(10)$ given that $y(5) = 12$, $y(6) = 13$, $y(9) = 14$, $y(11) = 16$

Or

14. Explain the Lagrange's interpolation method with unequal intervals.

Module 3

15. In numerical integration, what should be the number of intervals to apply Simpson's one-third rule and Simpson's three-eighth rule?

Or

16. State the two point Gaussian quadrature formula to evaluate $\int f(x) dx$

Module 4

17. Explain the Fourth order Runge - Kutta method for solving first order equations.

Or

18. Explain the Milne's and Adams - Bashforth predictor corrector methods for solving first order equations.

Module 5

19. How will you solve second order two - point linear boundary value problems using Finite difference methods

Or

20. a. Explain the One dimensional wave equation by explicit method.

b. Explain One dimensional heat flow equation by implicit (Crank Nicholson) method

SYLLABUS

Module 1

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices.

Module 2

Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae

Module 3

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's $1/3$ rule, Simpson's $3/4$ rule – Romberg's Method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's $1/3$ rules

Module 4

Single step methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations

Module 5

Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

Text Books

1	Numerical Analysis	Burden, R.L and Faires	Cengage Learning, 2016
2	Numerical Methods in Engineering and Science	Grewal, B.S., and Grewal, J.S.	Khanna Publishers, 10 th Edition, New Delhi, 2015

Reference Books

1	A Friendly Introduction to Numerical Analysis	Brian Bradie	Pearson Education, Asia, New Delhi, 2007.
2	Applied Numerical Analysis	Gerald. C. F. and Wheatley. P. O	Pearson Education, Asia, 6 th Edition, New Delhi, 2006

AUTOMOBILE ENGINEERING

3	Numerical Methods for Mathematics, Science and Engineering	Mathews, J.H.	2 nd Edition, Prentice Hall,1992.
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Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Module 1 (7 hours)	
1.1	Solution of algebraic and transcendental equations - Fixed point iteration method.	1
1.2	Newton Raphson method - Solution of linear system of equations	1
1.3	Gauss elimination method – Pivoting - Gauss Jordan method –	2
1.4	Iterative methods of Gauss Jacobi and Gauss Seidel -	2
1.5	Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices	1
2	Module 2 (7 hours)	
2.1	Interpolation with unequal intervals - Lagrange's interpolation	2
2.2	Newton's divided difference interpolation	1
2.4	Cubic Splines - Difference operators and relations	2
2.5	Interpolation with equal intervals - Newton's forward difference formulae	1
2.6	Newton's backward difference formulae	1
3	Module 3 (7 hours)	
3.1	Approximation of derivatives using interpolation polynomials	2
3.2	Numerical integration using Trapezoidal, Simpson's 1/3 rule , 3/4 rule – .	2
3.3	Romberg's Method - Two point and three point Gaussian quadrature formulae	2
3.4	Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules	1
4	Module 4 (7hours)	
4.1	Single step methods - Taylor's series method	1

AUTOMOBILE ENGINEERING

4.2	Euler's method - Modified Euler's method -	2
4.3	Fourth order Runge - Kutta method for solving first order equations	2
4.4	Multi step methods - Milne's and Adams	1
4.5	Bash forth predictor corrector methods for solving first order equations	1
5	Controlling emission -Module 5 (8 hours)	
5.1	Finite difference methods for solving second order two - point linear boundary value problems.	2
	Finite difference techniques for the solution of two dimensional Laplace's equation on rectangular domain	2
5.2	Finite difference techniques for the solution of two dimensional Poisson's equations on rectangular domain	2
5.3	One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods	1
5.4	One dimensional wave equation by explicit method	1

AUTOMOBILE ENGINEERING

AUT332	VEHICLE INSPECTION AND MAINTENANCE	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: On completion of this course, the students will be able to inspect and diagnose the problems occurring in the various components of the vehicle.

- ✓ To make the student understand the need for vehicle maintenance and its importance
- ✓ To familiarize the maintenance procedure for various components of an automobile
- ✓ To impart knowledge on maintenance of vehicles to ensure maximum life to vehicles
- ✓ To identify various troubles occurred for the vehicles from various symptoms shown.
- ✓ To know about the various methods of maintaining vehicles and their subsystems
- ✓ To gain basics knowledge for preparing the inspection schedule

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the importance of vehicle inspection and maintenance
CO 2	Understand the owner maintenance schedule of various automobiles
CO 3	Diagnose the causes of common vehicle problems and provide remedial action
CO 4	Understand the maintenance of electric vehicle
CO 5	Possess the knowledge about the inspection and maintenance of modern vehicle systems

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	1	-		-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	2	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	2	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50

AUTOMOBILE ENGINEERING

Apply			
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1)

1. Write the importance of maintenance in vehicles.
2. With a neat sketch explain requirements and personnel of a vehicle service station.
3. Explain the various methods of towing vehicles with neat sketches quoting advantages and disadvantages.

Course Outcome 2 (CO2)

1. Explain the troubles and troubleshooting related to engines.
2. How do you conduct battery testing in vehicles? Why it is required?
3. Explain the maintenance schedule of any L.M.V?

Course Outcome 3(CO3):

1. Explain the servicing of braking system in vehicles.
2. What do you mean by wheel alignment? Why it is important?
3. What are the various troubles related to clutches in vehicles. How do you rectify

Course Outcome 4 (CO4):

1. What are the major problems encountered in on board charger and give suitable remedies?
2. What is the function of LDC?
3. What are the various fuses used in instrument panel of EV. explain the various circuits protected by them

Course Outcome 5 (CO5):

1. What are the various software tools used for the error diagnostics in new generation vehicles?
2. Explain the procedure of conducting OBD in vehicles.
3. What are the common types of sensors used in vehicles? Explain the principle of working.

Model Question paper

QP CODE:

PAGES:2

Reg. No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT332

Course Name: VEHICLE INSPECTION AND MAINTENANCE

Max. Marks: 100

Duration: 3 Hours

PART A

Each question carries 3 Marks (2 questions from each module)

1. Differentiate preventive maintenance from breakdown maintenance.
2. List out the various tools and equipment's used in a garage?
3. What is the difference between semi synthetic and synthetic engine oil?
4. How do you test the battery?
5. What is braking efficiency? How stopping distance test is carried out?
6. What is tyre rotation? What is the schedule at which it has to be done?
7. What is the importance of LDC?

AUTOMOBILE ENGINEERING

8. How do you maintain the high voltage battery of electric vehicle?
9. What is meant by engine management system?
10. Mention various sensors used in fuel supply system.

Answer any one full question from each module.

Each question carries 14 Marks

11. With a neat sketch explain requirements and personnel of a vehicle service station (14)

Or

12. Explain the various methods of towing vehicles with neat sketches quoting advantages and disadvantages (14)

13. Explain the maintenance schedule of any L.M.V (14)

Or

14. Write down the step by step procedure in brief about dismantling of an engine for major overhauling (14)

15. a. What is meant by clutch pedal free play? How do you adjust it? (7)

- b. What is meant by bleeding of hydraulic brakes? How it is done? (7)

Or

16. Explain the common gearbox problems and its remedies (14)

17. Explain the maintenance schedule of any E.V (14)

Or

18. What are the various fuses used in instrument panel & motor compartment panel of EV. explain the various circuits protected by them (14)

19. What are the salient features of OBD II? How it is different from OBD I? (14)

Or

20. Describe the process of using scan tool to diagnose the trouble code of a vehicle. (14)

SYLLABUS

Module 1

Maintenance, Necessity of maintenance, types of maintenance, preparation of check lists – various formats. Maintenance of records, log sheets and other forms, safety precautions in maintenance: General safety, tool safety.

Service station - layouts, requirements and personnel for service station, Basic tools, special purpose tools, measuring instruments–Towing and recovering of vehicles.

Module 2

Engine compartment – Illustration and inspection, Routine maintenance of Diesel & Petrol vehicles. Checking the engine oil level, Changing the engine oil and filter, checking the coolant level, maintenance of air filter, Fuel filter, checking the brake/clutch fluid, washer fluid. Scheduled maintenance services of Petrol, Diesel vehicles. Maintenance of Petrol, Diesel vehicles under severe usage conditions.

Inspection of drive belts, Spark plugs, Engine – service, repair and overhaul. Valve clearance. Maintenance of Battery.

Module 3

Clutch – Common clutch problems & service. Maintenance of AMT, CVT & DSG. Gearbox - Common gearbox problems & service.

Brake overhauling, Cleaning, adjustment and replacement of braking components. Brake bleeding. Tyres and wheels maintenance – tyre rotation, wheel balancing & wheel alignment. Suspension System – service, repair and overhaul.

Module 4

Motor compartment – Illustration and inspection, Routine maintenance of EV - Scheduled maintenance services of EV, Maintenance of EV under severe usage conditions.

Maintenance of On-Board Charger (OBC), Inverter, LDC, Motor, Reduction gear, High voltage battery

Fuses – types, Fuse switch, Fuse replacement - Motor compartment panel, Instrument panel. Fuse/relay panel description - Motor compartment panel, Instrument panel -Fuse names, symbols, fuse rating and circuit protected.

Module 5

Introduction to maintenance of new generation vehicles- On board Diagnostics- procedure of on board diagnostics, software tools used for the error diagnostics - common types of sensor errors and rectification. Maintenance of level 0 – level 5 autonomous vehicles.

Text Books

1	Vehicle Maintenance and Garage Practice	PHI Learning Private Limited	Jigar A Doshi , Dhruv U Panchal , Jayesh P Maniar
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Reference Books

2	Automotive mechanics		Crouse & Anglin
3	Service manuals of various OEMs		
4	Automotive Service: Inspection, Maintenance, Repair		Tim Gilles

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Module 1 (7 hours)	
1.1	Maintenance, Necessity of maintenance, types of maintenance	1
1.2	Preparation of check lists – various formats. Maintenance of records, log sheets and other forms	1
1.3	Safety precautions in maintenance: General safety, tool safety.	2
1.4	Service station - layouts, requirements and personnel for service station, Towing and recovering of vehicles.	2
1.5	Basic tools, special purpose tools, measuring instruments	1
2	Module 2 (7 hours)	
2.1	Engine compartment – Illustration and inspection, Routine maintenance of Diesel & Petrol vehicles.	1
2.2	Checking the engine oil level, Changing the engine oil and filter, checking the coolant level, maintenance of air filter, Fuel filter, checking the brake/clutch fluid, washer fluid.	1
2.3	Scheduled maintenance services of Petrol, Diesel vehicles. Maintenance of Petrol, Diesel vehicles under severe usage conditions.	1
2.4	Inspection of drive belts, Spark plugs	1
2.5	Maintenance of Battery	1
2.6	Engine – service, repair and overhaul. Valve clearance.	2

AUTOMOBILE ENGINEERING

3	Module 3 (8 hours)	
3.1	Clutch – Common clutch problems & service.	2
3.2	Brake overhauling, Cleaning, adjustment and replacement of braking components. Brake bleeding.	2
3.3	Tyres and wheels maintenance – tyre rotation, wheel balancing & wheel alignment.	2
3.4	Suspension System – service, repair and overhaul. Gearbox - Common gearbox problems & service.	2
4	Module 4 (7 hours)	
4.1	Motor compartment – Illustration and inspection, Routine maintenance of EV - Scheduled maintenance services of EV, Maintenance of EV under severe usage conditions.	2
4.2	Maintenance of On-Board Charger (OBC), Inverter, LDC, Motor, Reduction gear, High voltage battery	1
4.3	Fuses – types, Fuse switch, Fuse replacement - Motor compartment panel, Instrument panel. Fuse/relay panel description	2
4.4	Motor compartment panel, Instrument panel -Fuse names, symbols	1
4.5	Fuse rating and circuit protected.	1
5	Module 5 (7 hours)	
5.1	Introduction to maintenance of new generation vehicles	1
5.2	On board Diagnostics- software tools used for the error diagnostics in new generation vehicles	1
5.3	Common types of sensor errors and rectification	1
5.4	Procedure of on board diagnostics	1
5.5	Maintenance of level 0, 1, 2 vehicles.	2
5.6	Maintenance of level 3, 4, 5 vehicles.	1

AUTOMOBILE ENGINEERING

AUT342	VEHICLE PERFORMANCE AND TESTING	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: The aim of this subject is to make students familiarize with the various tests performed on a vehicle, to study and analyse its performance Characteristics.

- ✓ Explain about various laboratory testing procedures of the engine on dynamometer to study about basic engine parameters.
- ✓ To impart basic knowledge about engine exhaust analysers for petrol and diesel engine.
- ✓ To impart basic concepts of Collision Testing and Wind Tunnel Testing of vehicles
- ✓ To study about the role of Noise Vibration and Harshness in automobile and to know about various Ride vibration and body test procedure.
- ✓ To understand about Wheels and braking performance test procedure.

Prerequisite: Auto Chassis, Vehicle Body Engineering

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the basic engine parameters and various laboratory testing procedures.
CO 2	Knowledge about engine exhaust analysers for petrol and diesel engine.
CO 3	Explain the basic concepts of Collision testing and Wind Tunnel testing of vehicles
CO 4	Explain the role of Noise Vibration and Harshness in automobile and to know about various Ride vibration and body test procedure.
CO 5	Understand about Wheels and Braking performance test procedure.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	-	-	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50

AUTOMOBILE ENGINEERING

Understand	25	25	50
Apply			
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain about the basic engine parameters.
2. Discuss about different laboratory testing procedures of the engine on dynamometer.

Course Outcome 2 (CO2)

- 1.Explain about various exhaust gas analysers used for petrol engine.
- 2.Discuss about Energy consumption tests performed on engine.
3. Briefly explain about Fuel Consumption Test performed on a vehicle.

Course Outcome 3(CO3):

1. Explain about various Collision and Crash Testing procedure performed on a vehicle.
2. Discuss about Wind Tunnel Testing procedure of vehicles.

Course Outcome 4 (CO4):

1. Identify and explain the different sources of noise in a vehicle.

2. Discuss about Standard noise measurement methods and noise control methods.
3. Briefly explain about Vibration measurement tests performed on a vehicle.

Course Outcome 5 (CO5):

1. Discuss about different type of Wheels and braking performance test performed on a vehicle.
2. Explain about various test conducted to check the performance of Air and hydraulic brake.

Model Question paper

QP CODE:

PAGES: 3

Reg. No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT342

Course Name: VEHICLE PERFORMANCE AND TESTING

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. Define IP, BP and FP. Explain why engines are tested on dynamometers?
2. Differentiate between two wheel & four wheel dynamometers.
3. Explain about different types of exhaust gas analysers used for petrol and diesel engines.
4. What are the factors to be considered while conducting fuel consumption test?
5. List importance of collision and crash testing. What is meant by crashworthiness of a vehicle?
6. Discuss the factors to be considered while conducting wind tunnel testing of vehicles.
7. What is meant by NVH? Mention the importance of NVH in vehicle design.
8. What are the different types of noises originating from a vehicle?
9. Differentiate between Dynamic cornering fatigue test and dynamic radial fatigue tests.
10. Explain about the factors to be considered while designing a front bumper of a vehicle?

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11. Explain the principle of following dynamometers.

a. Hydraulic dynamometer (7)

b. Eddy current dynamometer (7)

Or

12. Explain the procedure of testing vehicle on chassis dynamometers. (14)

Module 2

13. Explain different types exhaust gas analysers used for petrol and diesel engines. (14)

Or

14. Briefly explain the procedure of conducting fuel consumption tests. (14)

Module 3

15. Explain the procedure of collision and crash testing conducted on vehicles. (14)

Or

16. a. Explain in detail about wind tunnel testing of vehicle. (7)

b. What are the factors that affect the aerodynamic efficiency of the vehicle? (7)

Module 4

17 a. Explain about different types of standard noise measurement methods.

(7) b. Discuss how sound insulation is achieved in vehicles. (7)

Or

18. a. Discuss about different sources of noise in a vehicle. How they are originated. (7)

b. Discuss about the process of ride vibration isolation in vehicles. (7)

Module 5

19. Explain the road hazard impact test for wheel and tyre assemblies. (14)

Or

20. a. Differentiate between drawbar pull test and grade holding test for testing parking brake. (7)
- b. Explain the procedure of dynamic cornering fatigue test. (7)

SYLLABUS

Module 1

Laboratory testing: Basic engine parameters, Measurement of BHP, IHP- Engine testing on dynamometers, different types of dynamometers- hydraulic, eddy current etc. Vehicle testing on chassis dynamometers: two wheel & four wheel dynamometers, vehicle testing lanes - side slip testers, brake testers, head light alignment testing.

Module 2

Engine analysers- for petrol and diesel engines, exhaust gas analysers - various types- Orsat apparatus, infrared gas analysers, smoke meter. Energy consumption tests- Engine Cooling fan, air conditioning and brake compressors. Fuel Consumption Test, test route selection, Vehicle test speeds.

Module 3

Collision And Crash Testing : Human Testing, Dummies, Crash worthiness, pole crash testing, near crash testing, vehicle to vehicle impact, side impact testing, crash test sensor, sensor mounting positions, crash test data acquisition, braking distance test.

Wind Tunnel Test: Test requirements – ground boundary simulation- wind tunnel selection and Reynolds number capability, model requirements, model details, model mounting, test procedure.

Module 4

Noise vibration and Harshness: Automotive noise criteria, Standard noise measurement methods, Noise inside and outside the vehicle, sources of vehicle noise- intake and exhaust noise, combustion noise, mechanical noise, noise from auxiliaries, wind noises, transmission noises, brake squeal, structure noise, noise control methods.

Ride vibration and body test: Vibration measurement instrument – accelerometer and signal conditioning.

Module 5

Wheels and braking performance test: Dynamic cornering fatigue, dynamic radial fatigue tests – procedure. Impact test – road hazard impact test for wheel and tyre assemblies, test procedures, failure criteria and performance criteria. Bumpers - types of tests, pendulum test, fixed collision barrier test procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements. Parking brake – drawbar pull test, grade holding test.

Text Books

1	Automotive Mechanics	Crouse W.H.and Anglin D.L	Tata McGraw-Hill Publishing Co
2	Vehicle operation and performance	J. G. Giles	Wildlife Publications, London, 1969
3	Mechanical Measurements	Beck with. T.G. and Buck. N.L.	Addition Wesley publishing company Limited, 1995.

Reference Books

4	ARAI Standards https://www.araiindia.com/downloads		
5	SAE Hand book, Vol 3, SAE, Publications, 2000		
6	Automotive Handbook, Bosch. Website: www.mainindia.com/Draft , AIS standards.		
7	SAE Transaction papers – 831814, 820346, 820367, 820371, 820375		
8	Automotive technology	Dr. N.K.Giri	Khanna publishers, 2009
9	Motor vehicle inspection	W. H. Crouse and L. Anglin	McGraw Hill Book Co. 1978.

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Laboratory testing Module 1 (7 hours)	
1.1	Definition of basic engine parameters. BHP, IHP, FHP	1
1.2	Different types of dynamometers- hydraulic, eddy current	1
1.3	Engine testing on dynamometers -Measurement of BHP, IHP	1
1.4	Vehicle testing on chassis dynamometers: two wheel& four wheel dynamometers	2
1.5	Vehicle testing lanes - side slip testers, brake testers, head light alignment testing.	2

AUTOMOBILE ENGINEERING

2	Engine analysers Module 2 (7 hours)	
2.1	Engine analyzers- for petrol and diesel engines.	1
2.2	Exhaust gas analyzers - Orsat apparatus, infrared gas analyzers, smoke meter	1
2.3	Energy consumption tests-Engine Cooling fan, air conditioning	1
2.4	Energy consumption tests - brake compressors.	2
2.5	Fuel Consumption Test, test root selection, Vehicle test speeds.	2
3	Collision and Crash Testing, Wind Tunnel Test Module 3 (7 hours)	
3.1	Collision And Crash Testing of vehicles. Human Testing, Dummies, Crash worthiness of the vehicle.	1
3.2	Pole crash testing, near crash testing, vehicle to vehicle impact, side impact testing.	1
3.3	Crash test sensor, sensor mounting positions, braking distance test.	1
3.4	Wind Tunnel Test: Test requirements – ground boundary simulation- wind tunnel selection	2
3.5	Reynolds number capability, model requirements, model details, model mounting, test procedure.	2
4	Noise vibration and Harshness Module 4 (7 hours)	
4.1	Automotive noise criteria, Standard noise measurement methods, Noise inside and outside the vehicle	1
4.2	Sources of vehicle noise- intake and exhaust noise, combustion noise, mechanical noise	1
4.3	Noise from auxiliaries, wind noises, transmission noises, brake squeal, structure noise, noise control methods.	2
4.4	Ride vibration and body test: Vibration measurement instrument – accelerometer and signal conditioning.	3
5	Performance Testing Module 5 (8 hours)	
5.1	Wheels and braking performance test: Dynamic cornering fatigue, dynamic radial fatigue tests – procedure.	2
5.2	Impact test – road hazard impact test for wheel and tyre assemblies, test procedures, failure criteria and performance criteria.	2
5.3	Bumpers - types of tests, pendulum test, fixed collision barrier test procedure, performance criteria.	2
5.4	Air and hydraulic brake test, air brake actuator, valves test, performance requirements. Parking brake – drawbar pull test, grade holding test.	2

AUTOMOBILE ENGINEERING

AUT352	AUTOMOTIVE POLLUTION AND TESTING	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: The aim of this subject is to offer the students a general understanding of emissions of automotive engines and the emission testing methods.

- ✓ To impart knowledge about pollutants and emission standards
- ✓ To impart the basic concepts pollutant formation
- ✓ To impart knowledge in technology for controlling emission
- ✓ To impart knowledge in emission testing procedures
- ✓ To discuss methods of controlling automotive pollution

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand about pollutants and emission standards
CO 2	Discuss the basic concepts pollutant formation
CO 3	Understand the technology for controlling emission
CO 4	Explain emission testing procedures
CO 5	Understand the methods of controlling automotive pollution

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			

AUTOMOBILE ENGINEERING

Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the sources of pollutants
2. Explain emission standards and regulations

Course Outcome 2 (CO2)

1. Explain the mechanism of pollutant formation in SI and CI engines

Course Outcome 3(CO3):

1. Explain the technology for controlling emissions

Course Outcome 4 (CO4):

- 1.Explain the emission measurement and testing procedures

Course Outcome 5 (CO5):

2. Discuss the inspection procedures for SI engines.
3. Discuss the methods for controlling pollution

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT 352

Course Name: AUTOMOTIVE POLLUTION AND TESTING

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. What are the effects of pollution on environment and human?
2. Mention any two pollutants and their sources.
3. Explain the formation of NO_x and CO in CI engines.
4. Explain the formation of particles in CI engines.
5. Explain the construction of three way catalytic convertor.
6. Brief on i)Crank Case emission ii) Evaporative emission
7. What are the emission standards for inspection and maintenance?
8. Brief on emission measurement in two wheelers.
9. Write notes on vehicle replacement and retrofit program.
10. What is Intelligent vehicle Highway system.

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11. Explain the International Emission Standards (14)

Or

12. Explain the Certification procedure in detail. (14)

Module 2

13. Explain the formation of hydrocarbons in CI and SI engines. (14)

Or

14. Explain the mechanism of pollutant formation (14)

Module 3

15. Explain the construction and working of two way and three way converters . (14)

Or

16. Explain the fuel dispensing and distribution emission (14)

Module 4

17. Explain the remote sensing of vehicle emission. (14)

Or

18. Explain the construction of NDIR analyser (14)

Module 5

19. What are the inspection procedures for SI engines in controlling emission (14)

Or

20. Compare the centralized and de centralized Inspection and Maintenance procedure (14)

SYLLABUS

Module 1

Introduction : Pollutants – sources – formation – effects of pollution on environment – human. Emission standards & regulations – international standards, US, European union standards, & Indian standards. Compliance with standards – certification - assembly lane testing – In use surveillance & recall.

Module 2

Mechanism of pollutant formation – formation of NO_x & CO in SI and CI engines – formation of particles in SI and CI engines – oxidation of soot – role of soot inhibitors
Formation of HC – aldehydes, ketones, alcohols and organic acids - formation of HC in SI and diesel engines.

Module 3

AUTOMOBILE ENGINEERING

Technology for controlling emissions – Gasoline fueled vehicles – A/F ratio, electronic control. Catalytic convertors – two way and three way convertors – catalytic wear and poisoning. Diesel fuelled vehicles – engine design – exhaust after treatment – EGR- Crankcase emission and control - evaporative emission and control – fuel dispensing and distribution emissions and control, SCR

Module 4

Emission standards for inspection and maintenance – cost and benefits – emission improvements – impact of tampering – cost effectiveness. Remote sensing of vehicle emissions – evaluation of data. Emission measurement and testing procedures – light and heavy duty vehicles & two wheelers. Crankcase, evaporative, refueling and on-road emissions. NDIR analyzers, FID, Chemiluminescence analyzers etc.

Module 5

Controlling emission - inspection procedures for SI engines – exhaust & evaporative emissions – motorcycle white smoke. Institutional setting for inspection and maintenance – centralized and decentralized I/M – comparison – inspection frequency and roadside inspection
Vehicle replacement and retrofit programs – scrapage and relocation – replacement – retrofit program. Intelligent vehicle- highway systems.

Text Books

1	Air pollution from motor vehicles	Asil Faiz, C S Weaver, M P Walsh	The World bank , Washington D C, 1996
2	Automobiles and pollution	Paul Degobert,	Editions Technip, 1995

Reference Books

3	Automotive Fuel and Emissions Control Systems	James D. Halderman	Pearson, 2012
5	Engine Emission	Springer and Patterson	Plenum Press, 1990
6	Automotive emission control,	W.M. Crouse and A.L. Anglin	McGraw Hill Co., New York, 1993

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Introduction Module 1 (7 hours)	
1.1	Introduction :Sources of Pollutants and formation	1
1.2	Effects of pollution on environment and human.	1
1.3	Emission standards & regulations – international standards -US, European union standards,	2
1.4	Emission standards & regulations - Indian standards	1
1.5	Compliance with standards – certification - assembly lane testing – In use surveillance & recall.	2
2	Mechanism of pollutant formation - Module 2 (7 hours)	
2.1	Mechanism of pollutant formation – formation of NO _x & CO in SI engines	1
2.2	Mechanism of pollutant formation – formation of NO _x & CO in CI engines	1
2.3	Formation of particles in SI and CI engines.	2
2.4	Oxidation of soot – role of soot inhibitors	1
2.5	Formation of HC – aldehydes, ketones, alcohols and organic acids - formation of HC in SI and CI engines.	2
3	Technology for controlling emissions -Module 3 (7 hours)	
3.1	Technology for controlling emissions – Gasoline fueled vehicles – A/F ratio, electronic control	2
3.2	Catalytic convertors – two way and three way convertors – catalytic wear and poisoning control – fuel dispensing and distribution emissions and control.	2
3.3	Diesel fuelled vehicles – engine design – exhaust after treatment – EGR, SCR	2
3.4	Crankcase emission and control - evaporative emission and control.	1
4	Emission standards for inspection and testing procedures- Module 4 (7hours)	
4.1	Emission standards for inspection and maintenance – cost and benefits	1
4.2	Emission improvements – impact of tampering – cost effectiveness	1
4.3	Remote sensing of vehicle emissions – evaluation of data.	1
4.4	Emission measurement and testing procedures – light and heavy duty vehicles & two wheelers.	2

AUTOMOBILE ENGINEERING

4.5	Crankcase, evaporative, refueling and on-road emissions. NDIR analyzers, FID, Chemiluminescence analyzers etc.	2
5	Controlling emission -Module 5 (8 hours)	
5.1	Controlling emission - inspection procedures for SI engines	2
5.2	Exhaust & evaporative emissions – motorcycle white smoke.	1
5.3	Institutional setting for inspection and maintenance – centralized and decentralized I/M	2
5.4	Comparison – inspection frequency and roadside inspection. Vehicle replacement and retrofit programs – scrapage and relocation – replacement – retrofit program.	2
5.5	Intelligent vehicle- highway systems	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer only one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Explain mechatronics and its application
2. Explain different sensors

Course Outcome 2 (CO2):

1. Explain microprocessors and microcontrollers
2. Explain 8085 microprocessor
3. Explain 8051 microcontroller

Course Outcome 3 (CO3):

1. Explain programmable peripheral interface
2. Explain PLC

Course Outcome 4 (CO4):

1. Explain types of motors
2. Case studies of mechatronics system

Course Outcome 5 (CO5):

1. Explain MEMS and micro systems
2. Explain application of micro systems in automobiles

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT362

Course Name: MECHATRONICS & CONTROL SYSTEMS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. Describe the function of intelligent mechatronics systems.
2. Write any two applications of hall effect sensor.
3. Classify the addressing modes of 8085.
4. Explain about different ports of 8051.
5. Express the types of excitation are possible in a stepper motor?
6. Explain the general rules to write a ladder logic diagram
7. Compare AC & DC Servomotors.
8. What are the different types of stepper motor based on construction?
9. Explain the difference between MEMS and microsystems.
10. Why cannot microelectronics technology be adopted in the design and packaging of MEMS and microsystems product?

PART B

Answer any one full question from each module

Each question carries 14 Marks

11. What do you understand by the term Mechatronics? With a neat diagram, show the basic elements of a Mechatronic system. Give examples of Mechatronic systems. 14 marks

OR

AUTOMOBILE ENGINEERING

12. Explain with a neat sketch about strain gauge. 14 marks
13. Describe the various types of instruction set in 8085 microprocessor. 14 marks

OR

14. Discuss architecture of 8051 microcontroller. 14 marks
15. What are the requirements for temperature control system? Explain it. 14 marks

OR

16. Explain a circuit that can be used to start a motor and then after a delay of 100s start a pump when the motor is switched off there should a delay of 10s before the pump is switched off. 14 marks
17. Explain the construction and working principle of stepper motor. 14 marks

OR

18. Explain the concept of Car engine management system by mechatronics approach. 14 marks
19. Explain application of micro systems in the automotive industry. 14 marks

OR

20. Describe the three principal signal transduction methods for micro pressure sensors. Provide at least one major advantage and disadvantage of each these methods. 14 marks

SYLLABUS

Module 1

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors

Module 2

Microprocessor and Microcontroller: Introduction – Architecture of 8085 – Pin Configuration– Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram

Module 3

Programmable Peripheral Interface: Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

Programmable Logic Controller: Introduction – Basic structure – Input and output processing– Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC- Basic programmes

Module 4

Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier.

Module 5

MEMS: Introduction, MEMS and micro system products, application of micro systems in the automotive industry, working principles of micro systems – Micro Sensors- Acoustic wave sensor, Biomedical Sensors and Biosensors, Chemical Sensors, Pressure Sensors- Micro actuation- Actuation using thermal forces, Actuation using Shape-memory alloys, Actuation using Piezoelectric Crystals, Actuation using Electrostatic forces- MEMS with micro actuators- Microgrippers, Micromotors, Microvalves, Micropumps- Micro accelerometers

Text Books:

1.	Mechatronics	Bolton W	Pearson Education Asia, New Delhi, 2002.
2..	Microprocessor Architecture, Programming, and Applications with the 8085	Ramesh S Gaonkar	5th Edition, Prentice Hall, 2008.
3.	MEMS & Microsystems- Design and Manufacture	Tai-Ran Hsu	Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 2003.

Reference Books:

1.	Mechatronics- Principles, Concepts and Applications	Nitaigour Premchand Mahalik	Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 2003.
2.	Mechatronics	HMT	Tata McGraw Hill Publishers, New Delhi, 2000.

AUTOMOBILE ENGINEERING

3.	Introduction to Mechatronics and Measurement Systems	David G Alciatore and Michael B Histan	Tata McGraw-Hill Pub. Co. Ltd., New Delhi,
4.	8051 Microcontroller, Architecture, Programming and Applications	Kenneth J Ayala	Penram International, India, 1996.

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Module 1 (7 hours)	
1.1	Introduction to Mechatronics – Systems	1
1.2	Concepts of Mechatronics approach – Need for Mechatronics	1
1.3	Emerging areas of Mechatronics – Classification of Mechatronics.	1
1.4	Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers	1
1.5	LVDT – Capacitance sensors	1
1.6	Strain gauges – Eddy current sensor	1
1.7	Hall effect sensor – Temperature sensors – Light sensors	1
2	Module 2 (6 hours)	
2.1	Microprocessor and Microcontroller: Introduction	1
2.2	Architecture of 8085 – Pin Configuration	2
2.3	Addressing Modes – Instruction set	1
2.4	Timing diagram of 8085	1
2.5	Concepts of 8051 microcontroller – Block diagram	1
3	Module 3 (7 hours)	
3.1	Programmable Peripheral Interface: Introduction –	1
3.2	Architecture of 8255, Keyboard interfacing, LED display – interfacing,	1
3.3	ADC and DAC interface, Temperature Control – Stepper Motor Control- Traffic Control interface.	1

AUTOMOBILE ENGINEERING

3.4	Programmable Logic Controller: Introduction	1
3.5	Basic structure – Input and output processing, Programming – Mnemonics – Timers, counters and internal relays	1
3.6	Data handling – Selection of PLC.	1
3.7	Basic PLC programmes	1
4	Module 4 (7 hours)	
4.1	Types of Stepper and Servo motors – Construction –	2
4.2	Working Principle – Advantages and Disadvantages.	1
4.3	Design process-stages of design process	1
4.4	Traditional and Mechatronics design concepts	1
4.5	Case studies of Mechatronics systems – Pick and place Robot	1
4.6	Engine Management system – Automatic car park barrier.	1
5	Module 5 (6 hours)	
5.1	MEMS: Introduction, MEMS and micro system products,	1
5.2	Application of micro systems in the automotive industry,	1
5.3	Working principles of micro systems – micro sensors, micro actuation	2
5.4	MEMS with micro actuators and micro accelerometers	2

AUT372	CAD /CAM	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

- ✓ To provide a comprehensive concept of the design aspects and its importance in computer assisted design and manufacture
- ✓ To examine technologies those have been developed to automate manufacturing operations
- ✓ Develop Transformations for 2D geometry modelling.

Course Outcomes: After the completion of the course the student will be able to

Mapping of course outcomes with program outcomes

[illegible]

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Explain the basic applications of CAD, CAM, CAE & CIM
2. Explain 2d transformations and an intro to 3D Graphics

Course Outcome 2 (CO2)

1. Explain the Geometric Modelling
2. Explain The working of Numerical Control
3. Explain the basic of FEM

Course Outcome 3 (CO3):

1. Explain the analysis of Numerical Part programming

2. Explain the process of computer aided programming

Course Outcome 4 (CO4):

1. Explain the computer aided process planning
2. Explain the working and application of Flexible manufacturing system

Course Outcome 5 (CO5):

1. Discuss the function of robots in Computer integrated manufacturing
2. Explain the components in robotics

Model Question paper

QP CODE:

PAGES:2

Reg. No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT372

Course Name: CAD / CAM

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. List out and explain the data exchange formats?
2. Explain the comparison of CAD with traditional designing
3. Explain the types of Geometric Modelling
4. Explain the topologies of DNC System
5. Explain the Numerical part programming
6. Write a shote note on APT Language structure
7. Explain the need and advantages of Flexible manufacturing system
8. Explain the Artificial intelligence in process planning
9. Explain the application of robot end effectors
10. Explain the kinematics of Robot Arm

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11. Explain the different types of 2D transformation (14)
- Or
12. Explain the 2D Graphics – Line and Circle Drawing Algorithm (14)

Module 2

13. Explain the different devices in NC System (14)
- Or
14. Briefly explain the different types of Numerical control machines. (14)

Module 3

15. Describe the types of NC Coordinate system and axes (14)
- Or
16. Explain the codes used for Computer Aided part programming (14)

Module 4

17. Briefly explain the general methodology of Group technology (14)
- Or
18. Explain the Just-in-time and Group technology applied to FMS (14)

Module 5

19. Explain the components of Robot Technology (14)
- Or
20. Explain the Direct and inverse kinematics Solution robot arm dynamics (14)

SYLLABUS

Module 1

Evolution of CAD/CAM and CIM, Industrial Look at CAD, Comparison of CAD with traditional designing, Application of Computers in Design

Topologies of CAD systems- Design database, graphic Standards, data Exchange Formats, virtual Reality.

2D graphics: Line drawing algorithms, DDA line algorithm – Circle drawing, Bresenham's circle drawing algorithm- 2D transformation: translation, rotation, scaling, reflection, clipping – 3D graphics basics

Module 2

Geometric Modelling: Wire Frame, Surface and Solid Modelling,- Engineering Analysis; design review and evaluation, Automated drafting

Numerical Control: Need, Classifications: point to point, Straight Cut and Contouring positioning – incremental and absolute systems- open and closed loop systems, DDA integrator and interpolators- resolution, CNC and DNC

Introduction to Finite Element Analysis: Introduction, Applications, basic concepts, discretization, elements types, nodes and degrees of freedom, mesh generation, constraints, loads, pre-processing and post-processing, Software packages

Module 3

NC part programming: part programming Fundamentals- manual programming – NC Coordinate systems and axes– sequence number, preparatory Functions

Computer aided part programming: Concept and need of CAP – CNC languages – APT language structure: Geometry Commands, Motion Commands, Post processor Commands, Compilation Control Commands- Programming exercise

Module 4

Computer Aided Process Planning: Concept; traditional and CAPP; Automated process planning: process planning, general methodology of group technology, Code structures of variant and generative process planning methods, AI in process planning, Process planning software's

Flexible Manufacturing systems: Introduction, Types, concepts, need and advantages of FMS, Cellular and FMS- JIT and GT applied to FMS

Module 5

Robot technology: Basic Components; robot end effectors – sensors in robotics – control of actuators in robot mechanisms (basics) – Control of robot joint, stepper motor, Direct drive actuators – hydraulic and pneumatic systems, Robot arm kinematics, Direct and inverse kinematics solution robot arm dynamics – Robot application: material transfer, machine loading and unloading, Pre cutting operations, assembly, inspection and welding

Text Books

1	Principles of interactive graphics	Newman and Sproull	McGraw-Hill
2	Numerical control of machine tools	Yoram Koren	McGraw-Hill

Reference Books

1	Introduction to Robotics	Craig John
2	CAD/CAM, PHI	Groover M P
3	Computer Graphics (in C Version), Prentice Hall.	Hearn and baker
4	Introduction to Robotics	John Craig

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	Introduction Module 1 (7 hours)	
1.1	Evolution of CAD/CAM and CIM, Industrial Look at CAD	1
1.2	Comparison of CAD with traditional designing, Application of Computers in Design	1
1.3	Topologies of CAD systems- Design database, graphic Standards, data Exchange Formats, virtual Reality.	1
1.4	2D graphics: Line drawing algorithms, DDA line algorithm – Circle drawing, Bresnham's circle drawing algorithm-	2
1.5	2D transformation: translation, rotation, scaling, reflection, clipping – 3D graphics basics	2
2	Module 2 (7 hours)	
2.1	Geometric Modelling: Wire Frame, Surface and Solid Modelling,- Engineering Analysis; design review and evaluation, Automated drafting	1
2.2	Numerical Control: Need, Classifications: point to point, Straight Cut and Contouring positioning –	1
2.3	incremental and absolute systems- open and closed loop systems, DDA integrator and interpolators- resolution, CNC and DNC	2
2.4	Introduction to Finite Element Analysis: Introduction, Applications,	2

AUTOMOBILE ENGINEERING

	basic concepts, discretization, elements types, nodes and degrees of freedom,	
2.5	mesh generation, constraints, loads, pre-processing and post-processing	1
3	Module 3 (8 hours)	
3.1	NC part programming: part programming Fundamentals- manual programming	1
3.2	NC Coordinate systems and axes – sequence number, preparatory Functions	1
3.3	Computer Aided part programming: Concept and need of CAP	1
3.4	CNC languages – APT language structure: Geometry Commands, Motion Commands	2
3.5	Post processor Commands, Compilation Control Commands- Programming exercise	3
4	Module 4 (7hours)	
4.1	Computer Aided Process Planning: Concept; traditional and CAPP;	2
4.2	Automated process planning: process planning, general methodology of group technology, Code structures of variant and generative process planning methods, AI in process planning, Process planning software's	3
4.3	Flexible Manufacturing systems: Introduction, Types, concepts, need and advantages of FMS, Cellular and FMS- JIT and GT applied to FMS	2
5	Module 5 (7 hours)	
5.1	Robot technology: Basic Components; robot end effectors – sensors in robotics – control of actuators in robot mechanisms (basics)	2
5.2	Control of robo joint, stepper motor, Direct drive actuators – hydraulic and pneumatic systems,	2
5.3	Robot arm kinematics, Direct and inverse kinematics solution robot arm dynamics	2
5.4	Robot application: material transfer, machine loading and unloading, Pre cutting operations, assembly, inspection and welding	1