ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

PETROLEUM ENGINEERING

For

PE FOUR YEAR DEGREE COURSE

(Applicable for batches admitted from 2013-2014)

UNIVERSITY COLLEGE OF ENGINEERING KAKINADA
(Autonomous)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA - 533 003, Andhra Pradesh, India

ACADEMIC REGULATIONS R13 FOR B. TECH. (REGULAR)

Applicable for the students of B. Tech. (Regular) from the Academic Year 2013-14 onwards

1. Award of B. Tech. Degree

A student will be declared eligible for the award of B. Tech. Degree if he fulfils the following academic regulations:

1.1 A student shall be declared eligible for the award of the B. Tech Degree, if he pursues a course of study in not less than four and not more than eight academic years

1.2 The candidate shall register for 180 credits and secure all the 180 credits.

2. Courses of study

The following courses of study are offered at present as specializations for the B. Tech. Course:

S. No	Branch
01	Electronics and Communication Engineering
02	Electrical and Electronics Engineering
03	Civil Engineering
04	Mechanical Engineering
05	Computer Science and Engineering
06	Petro Chemical Engineering
07	Information Technology
08	Chemical Engineering
09	Electronics and Instrumentation Engineering
10	Bio-Medical Engineering
11	Aeronautical Engineering
12	Automobile Engineering
13	Bio Technology
14	Electronics and Computer Engineering
15	Mining Engineering
16	Petroleum Engineering
17	Metallurgical Engineering
18	Agricultural Engineering

3. Distribution and Weightage of Marks

(i) The performance of a student in each semester shall be evaluated subject – wise with a maximum of 100 marks for theory and 75 marks for practical subject. The project work shall be evaluated for 200 marks.

(ii) For theory subjects the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End - Examinations.

(iii) Out of 30 internal marks – 20 marks are assigned for subjective (**Theory, Design, Analysis, Simulation, Algorithms, Drawing, etc.**) examination 10 marks for objective examination.

(iv.) For theory subjects, during the semester there shall be 2 tests. The weightage of Internal marks for 30 consists of Descriptive – 15, Assignment - 05 (Theory, Design, Analysis, Simulation, Algorithms, Drawing, etc. as the case may be) Objective -10 (Conducted at College level with 20 Multiple choice question with a weightage of ½ Mark each). The objective examination is for 20 minutes duration. The subjective examination is for 120 minutes duration conducted for 40 marks.Each subjective type test question paper shall contain **4 questions** and all questions need to be answered. The Objective examination marks scaled for 10 and subjective examination marks scaled for 15 are to be added to the assignment marks of 5 for getting internal marks for 30. The better of the two tests will be taken for internal marks. As the syllabus is framed for 6 units, the 1st mid examination (both Objective and Subjective) is conducted in 1-3 units and second test in 4-6 units of each subject in a semester.

(v) The end semester examination is conducted covering the topics of all Units for 70 marks. Part – A contains a mandatory question (Brainstorming / Thought provoking / case study) for 22 marks. Part – B has 6 questions (One from each Unit). The student has to answer 3 out of 6 questions in Part – B and carries a weightage of 16 marks each.

(vi) For practical subjects there shall be continuous evaluation during the semester for 25 internal marks and 50 semester end examination marks. Of the 25 marks for internal, 15 marks shall be awarded as follows: day to day work 10 and Record-5, and 10 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the teacher concerned and external examiner.

(vii)For the subject having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 30 marks for internal evaluation (20 marks for day – to – day work, and 10 marks for internal tests) and 70 marks for end examination. There shall be two internal tests in a Semester and the better of the two shall be considered for the award of marks for internal tests.

(viii) For the seminar, the student shall collect the information on a specialized topic and prepare a technical report, showing his understanding over the topic, and submit to the department, which shall be evaluated by the Departmental committee consisting of Head of the department, seminar supervisor and a senior faculty member. The seminar report shall be evaluated for 50 marks. There shall be no external examination for seminar.

(ix)Out of a total of 200 marks for the project work, 60 marks shall be for Internal Evaluation and 140 marks for the End Semester Examination. The End Semester Examination (Viva – Voce) shall be conducted by the committee. The committee consists of an external examiner, Head of the Department and Supervisor of the Project. The evaluation of project work shall be conducted at the end of the IV year. The Internal Evaluation shall be on the basis of two seminars given by each student on the topic of his project and evaluated by an internal committee.

(x) Laboratory marks and the internal marks awarded by the College are not final. The marks are subject to scrutiny and scaling by the University wherever felt desirable. The internal and laboratory marks awarded by the College will be referred to a Committee. The Committee shall arrive at scaling factor and the marks will be scaled as per the scaling factor. The recommendations of the Committee are final and binding. The laboratory records and internal test papers shall be preserved in the respective departments as per the University norms and shall be produced to the Committees of the University as and when they ask for.

4. Attendance Requirements

4.1 A student is eligible to write the University examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

4.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee

4.3 Shortage of Attendance below 65% in aggregate shall not be condoned.

4.4 A student who is short of attendance in semester may seek re-admission into that semester when offered within 4 weeks from the date of the commencement of class work.

4.5 Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class.

4.6 A stipulated fee shall be payable towards condonation of shortage of attendance.

4.7 A student will be promoted to the next semester if he satisfies the attendance requirement of the present semester.

4.8 If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

5. **Minimum Academic Requirements**

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.4.

5.1 A student is deemed to have satisfied the minimum academic requirements if he has **earned the credits allotted to each theory/practical design/drawing subject/project andsecures not less than 35% of marks in the end semester exam, and minimum 40% of marks in the sum total of the internal marks and end semester examination marks.**

5.2 A student shall be promoted from first year to second year if he fulfills the minimum attendance requirement.

5.3 A student will be **promoted from II year to III year** if he fulfills the academic requirement **of 40% of the credits up to II year I semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.**

5.4 A student shall be **promoted from III year to IV year** only if he fulfils the academic requirements of **40% of the credits up to III year I semesterfrom all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.**

5.5 A student shall register and put up minimum attendance in all 180 credits and earn all 180 credits. **Marks obtained in the all 180 credits shall be considered for the calculation of percentage of marks.**

5.6 **Students who fail to earn 180 credits as indicated in the course structure within ten academic years (8 years of study + 2 years additionally for appearing for**

exams only) from the year of their admission, shall forfeit their seat in B.Tech. course and their admission stands cancelled.

6 Course pattern

6.1 The entire course of study is for four academic years, all the years on semester pattern.

6.2 **A student is eligible to appear for the end semester examination in a subject, but absent from it or has failed in the end semester examination, may write the exam in that subject when conducted next.**

6.3 **When a student is detained for lack of credits/shortage of attendance, he may be re-admitted into the same semester / year in which he has been detained. However, the academic regulations under which he was first admitted, shall continues to be applicable to him.**

7 Award of Class

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he shall be placed in one of the following four classes:

Class Awarded	% of marks to be secured	
First Class with Distinction	70% and above	**From the aggregate marks secured from 180 Credits.**
First Class	Below 70% but not less than 60%	
Second Class	Below 60% but not less than 50%	
Pass Class	Below 50% but not less than 40%	

The marks obtained in internal evaluation and end semester examination shall be shown separately in the memorandum of marks.

8 **Minimum Instruction Days**

The minimum instruction days for each semester shall be 90 working days.

9 There shall be no branch transfers after the completion of the admission process.

10 **There shall be no transfer from one college/stream to another within the Constituent Colleges and Units of Jawaharlal Nehru Technological University Kakinada.**

11 WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the university or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will be withheld in such cases.

12. **TRANSITORY REGULATIONS**

12.1 Discontinued, detained, or failed candidates are eligible for readmission as and when next offered.

12.2 After the revision of the regulations, the students of the previous batches will be given two chances for passing in their failed subjects, one supplementary and the other regular. If the students cannot clear the subjects in the given two chances, they shall be given equivalent subjects as per the revised regulations which they have to pass in order to obtain the required number of credits.

12.3 In case of transferred students from other Universities, the credits shall be transferred

to JNTUK as per the academic regulations and course structure of the JNTUK**.**

13. General

13.1 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

13.2 The academic regulation should be read as a whole for the purpose of any interpretation.

13.3 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

13.4 The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

13.5 The students seeking transfer to colleges affiliated to JNTUK from various other Universities/ Institutions have to pass the failed subjects which are equivalent to the subjects of JNTUK, and also pass the subjects of JNTUK on their own without the right to sessional marks which the candidates have not studied at the earlier Institution.

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ACADEMIC REGULATIONS R13 FOR B. TECH. (LATERAL ENTRY SCHEME)

Applicable for the students admitted into II year B. Tech. (LES) from the Academic Year 2013-14 and onwards

1 **Award of B. Tech. Degree (LES)**

A student will be declared eligible for the award of B. Tech. Degree (LES) if he fulfils the following academic regulations:

1.1 A student shall be declared eligible for the award of the B. Tech Degree (LES), if he pursues a course of study in not less than three academic years and not more than six academic years.

1.2 The candidate shall register for 132 credits and secure all the 132 credits.

2. The students, who fail to fulfil the requirement for the award of the degree in 8 consecutive academic years (6 years of study + 2 years additionally for appearing exams only) from the year of admission, shall forfeit their seats.

3. The attendance regulations of B. Tech. (Regular) shall be applicable to B.Tech. (LES).

4. **Promotion Rule**

A student shall be promoted from second year to third year if he fulfills the minimum attendance requirement.

A student shall be promoted from III year to IV year only if he fulfils the academic requirements of **40% of the credits up to III year I semesterfrom all the examinations. Whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.**

5. **Award of Class**

After a student has satisfied the requirement prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he shall be placed in one of the following four classes:

Class Awarded	% of marks to be secured	
First Class with Distinction	70% and above	**From the aggregate marks secured from 132 Creditsfrom II year to IV year.**
First Class	Below 70% but not less than 60%	
Second Class	Below 60% but not less than 50%	
Pass Class	Below 50% but not less than 40%	

The marks obtained in the internal evaluation and the end semester examination shall be shown separately in the marks memorandum.

6. All the other regulations as applicable to **B. Tech. 4-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme)**.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	**Punishment**
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work

		and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.

	of the examination.	
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for	

	further action to award suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)
   (i) A show cause notice shall be issued to the college.
   (ii) Impose a suitable fine on the college.
   (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA - 533 003, Andhra Pradesh, India

For Constituent Colleges and Affiliated Colleges of JNTUK

Ragging

Prohibition of ragging in educational institutions Act 26 of 1997

Salient Features

- Ragging within or outside any educational institution is prohibited.
- Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student

	Imprisonment upto		Fine Upto
Teasing, Embarrassing and Humiliation	6 Months		Rs. 1,000/-
Assaulting or Using Criminal force or Criminal intimidation	1 Year	+	Rs. 2,000/-
Wrongfully restraining or confining or causing hurt	2 Years		Rs. 5,000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	5 Years	+	Rs. 10,000/-
Causing death or abetting suicide	10 Months		Rs. 50,000/-

In Case of Emergency CALL TOLL FREE NO. : 1800 - 425 - 1288

LET US MAKE JNTUK A RAGGING FREE UNIVERSITY

For Constituent Colleges and Affiliated Colleges of JNTUK

ABSOLUTELY NO TO RAGGING

1. Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.
2. Ragging entails heavy fines and/or imprisonment.
3. Ragging invokes suspension and dismissal from the College.
4. Outsiders are prohibited from entering the College and Hostel without permission.
5. Girl students must be in their hostel rooms by 7.00 p.m.
6. All the students must carry their Identity Cards and show them when demanded
7. The Principal and the Wardens may visit the Hostels and inspect oms any time.

Jawaharlal Nehru Technological University Kakinada

For Constituent Colleges and Affiliated Colleges of JNTUK

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LET US MAKE JNTUK A RAGGING FREE UNIVERSITY

UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A), JNTUK
B. TECH. PETROCHEMICAL ENGINEERING (R – 13)

COURSE STRUCTURE

I YEAR

I Semester						II Semester					
S. No	**Subject Code**	**Subject Name**	**T**	**P**	**C**	**S. No**	**Subject Code**	**Subject Name**	**T**	**P**	**C**
1	PE111	English – I	3+1	--	3	1	PE121	English - II	3+1	--	3
2	PE112	Mathematics - I	3+1	--	3	2	PE122	Mathematics - II	3+1	--	3
3	PE113	Engineering Chemistry	3+1	--	3	3	PE123	Mathematics - III	3+1	--	3
4	PE114	Engineering Mechanics	3+1	--	3	4	PE124	Engineering Physics	3+1	--	3
5	PE115	Computer Programming	3+1	--	3	5	PE125	Professional Ethics & Human Values	3	--	3
6	PE116	Environmental Studies	3+1	--	3	6	PE126	Engineering Drawing	3+1	--	3
7	PE117	Engineering Chemistry Laboratory	--	3	2	7	PE127	English – Communication Skills Lab - II	--	3	2
8	PE118	English – Communication Skills Lab - I	--	3	2	8	PE128	Engineering Physics Laboratory	--	3	2
9	PE119	C Programming lab	--	3	2	9		Engineering Physics Virtual labs - Assignments	--	3	---
						10	PE129	Engineering Workshop & IT Workshop	--	3	2
					24						**24**

II YEAR

I Semester						II Semester					
S. No	**Subject Code**	**Subject Name**	**T**	**P**	**C**	**S. No**	**Subject Code**	**Subject Name**	**T**	**P**	**C**
1	PE211	Complex Variables	3+1		3	1		Probability & Statistics	3+1		3
2	PE212	General Geology	3+1		3	2		Petroleum Geology	3+1		3
3	PE213	Surveying and Offshore Structures	3+1		3	3		Materials Science & Engineering	3+1		3
4	PE214	Elements of Mechanical Engineering	3+1		3	4		Momentum Transfer	3+1		3
5	PE215	Basic Electrical & Electronics Engineering	3+1		3	5		Process heat Transfer	3+1		3
6	PE216	Chemical Process Calculations	3+1		3	6		Thermodynamics for Petroleum Engineers	3+1		3
7	PE217	Basic Engineering (Mech + Elec)Lab		3	2	7		Momentum Transfer Lab		3	2
8	PE218	Geology Lab & Surveying Lab		3	2	8		Process Heat Transfer Lab		3	2
					22						**22**

III YEAR

I Semester						IISemester					
S. No	**Subject Code**	**Subject Name**	**T**	**P**	**C**	**S. No**	**Subject Code**	**Subject Name**	**T**	**P**	**C**
1		Petroleum Exploration	3		3	1		Well Completions	3+1		3
2		Well Logging & Formation Evaluation	3		3	2		Petroleum Reservoir Engineering - I	3+1		3
3		Drilling Technology	3+1		3	3		Petroleum Production Engineering & Design	3+1		3
4		Well Engineering	3		3	4		Petroleum Refinery & Petrochemical Engineering	3		3
5		Process Instrumentation	3		3	5		Surface Production Operations	3		3
6		Process Dynamics & Control	3+1		3	6		IPR & Patents	2		2
7		Instrumentation & Process control Lab		3	2	7		Petroleum Analysis Lab		3	2
8		Drilling Fluids Lab		3	2	8		Drilling Simulation Lab		3	2
9		Industrial Visits				9		Summer Training (4-6 Weeks)		-	-
					22						**21**

IV YEAR

I Semester						II Semester					
S. No	**Subject Code**	**Subject Name**	**T**	**P**	**C**	**S. No**	**Subject Code**	**Subject Name**	**T**	**P**	**C**
1		Integrated Asset Management	3		3	1		Petroleum Economics, Regulations & Policies	3+1		3
2		Enhanced Oil Recovery Techniques	3+1		3	2		Elective – II ➢ Reservoir Modeling & Simulation ➢ Horizontal Well Technology ➢ LNG-Processes, transportation & Storage	3+1		3
3		HSE & FE in Petroleum Industry	3+1		3	3		Elective – III ➢ Reservoir Stimulation ➢ Subsea Engineering ➢ Fundamentals of Multiphase Flow	3+1		3
4		Petroleum Reservoir Engineering -II	3+1		3						
5		Open Elective: ➢ Operational Aspects of Well Testing ➢ Oil Field Chemicals ➢ Selected Topics in Petroleum Engineering	3+1		3						
6		Elective – I ➢ Offshore Engineering ➢ Pipeline Engineering ➢ Coal Bed Methane Engineering	3+1		3	4		Elective – IV ➢ Natural Gas Hydrates ➢ Advanced Natural Gas Engineering ➢ Petroleum Biotechnology	3+1 3+1 3+1		3
7		Petroleum Equipment Design and Simulation Lab		3	2						
8		Petroleum Reservoir Engineering Lab		3	2						
9		Presentation of SIP Report			2	5		Project			9
					24						**21**

Total Credits: 48 + 44 + 43 + 45 = 180

SYLLABUS

University College of Engineering Kakinada (A), JNTUK
I Year B. Tech. Petroleum Engineering – I Semester.

T	P	C
3+1	0	3

ENGLISH –I

(Common to All Branches)

DETAILED TEXT-I English Essentials: Recommended Topics:

1. **IN LONDON: M.K.GANDHI**
   OBJECTIVE: To apprise the learner how Gandhi spent a period of three years in London as a student.
   OUTCOME: The learner will understand how Gandhi grew in introspection and maturity.
2. **THE KNOWLEDGE SOCIETY- APJ KALAM**
   OBJECTIVE: To make the learners rediscover India as a land of Knowledge.
   OUTCOME: The learners will achieve a higher quality of life, strength and sovereignty of a developed nation.
3. **THE SCIENTIFIC POINT OF VIEW- J.B.S. HALDANE**
   OBJECTIVE: This essay discusses how scientific point of view seeks to arrive at the truth without being biased by emotion.
   OUTCOME: This develops in the student the scientific attitude to solve many problems which we find difficult to tackle.
4. **PRINCIPLES OF GOOD WRITING:**
   OBJECTIVE: To inform the learners how to write clearly and logically.
   OUTCOME: The learner will be able to think clearly and logically and write clearly and logically.
5. **MAN'S PERIL**
   OBJECTIVE: To inform the learner that all men are in peril.
   OUTCOME: The learner will understand that all men can come together and avert the peril.
6. **THE DYING SUN—SIR JAMES JEANS**
   OBJECTIVE: This excerpt from the book "The Mysterious Universe" presents the mysterious nature of the Universe and the stars which present numerous problems to the scientific mind. Sir James Jeans uses a poetic approach to discuss the scientific phenomena.
   OUTCOME: This provides the students to think about the scientific phenomena from a different angle and also exposes the readers to poetic expressions.
7. **LUCK—MARK TWAIN**
   OBJECTIVE: This is a short story about a man's public image and his true nature. The theme of the story is that luck can be a factor of life, so that even if one is incompetent but lucky, one can still succeed.
   OUTCOME: The story is humourous in that it contains a lot of irony. Thus this develops in the learner understand humourous texts and use of words for irony.

Text Book: 'English Essentials' by Ravindra Publications

NON-DETAILED TEXT:

(From Modern Trailblazers of Orient Blackswan)
(Common single Text book for two semesters)
(Semester I (1 to 4 lessons)/ Semester II (5 to 8 lessons)

1. **G.D.Naidu**
   OBJECTIVE: To inspire the learners by G.D.Naidu's example of inventions and contributions.
   OUTCOME: The learner will be in a position to emulate G.D.Naidu and take to practical applications.
2. **G.R.Gopinath**
   OBJECTIVE: To inspire the learners by his example of inventions.
   OUTCOME: Like G.R.Gopinath, the learners will be able to achieve much at a low cost and help the common man.
3. **Sudhamurthy**
   OBJECTIVE: To inspire the learners by the unique interests and contributions of Sudha Murthy.
   OUTCOME: The learner will take interest in multiple fields of knowledge and make life worthwhile through social service.
4. **Vijay Bhatkar**
   OBJECTIVE: To inspire the learner by his work and studies in different fields of engineering and science.
   OUTCOME: The learner will emulate him and produce memorable things.

Text Book: 'Trail Blazers' by Orient Black Swan Pvt. Ltd. Publishers

University College of Engineering Kakinada (A), JNTUK
I Year B. Tech. PetroleumEngineering – I Semester.

MATHEMATICS – I (DIFFERENTIAL EQUATIONS) (Common to All Branches)	T	P	C
	3+1	0	3

Course Learning Objectives:

The objectives of the course is to make the student understand the

- importance of matrix methods in high dimensional engineering problems (ex.: Electrical circuits) and finding the solutions of system of equations
- integral calculus over regions in plane and space and applications to area and volumes
- analyze and solve the engineering problems in mathematical aspect and interpret the solutions in terms of the actual problem

UNIT I: Linear systems of equations:

Rank-Echelon form, Normal form – Solution of Linear Systems – Direct Methods- Gauss Elimination - Gauss Jordon and Gauss Seidal Methods.
Application: Finding the current in an electrical circuit.

UNIT II: Eigen values - Eigen vectors and Quadratic forms:

Eigen values - Eigen vectors– Properties –Iteration method to find largest eigen value and eigen vectors -Cayley-Hamilton Theorem - Inverse and powers of a matrix by using Cayley-Hamilton theorem Quadratic forms- Reduction of quadratic form to canonical form – Rank - Positive, negative definite - semi definite - index – signature.
Application: Free vibration of a two-mass system.

UNIT III:Multiple integrals:

Review concepts of Curve tracing (Cartesian - Polar and Parametric curves)-
Applications of Integration to Lengths, and Surface areas of revolution in Cartesian and Polar Coordinates.
Multiple integrals - double and triple integrals – change of variables – Change of order of Integration
Application: Areas of surfaces and volumes of solids,Moments of inertia.

UNIT IV:Special functions:

Beta and Gamma functions- Properties - Relation between Beta and Gamma functions
Application: Evaluation ofimproper integrals

UNIT V: Vector Differentiation:

Gradient- Divergence- Curl - Laplacian and second order operators -Vector identities
Application: Equation of continuity, potential surfaces,irrotational fields, potential functions

UNIT VI: Vector Integration:

Line integral – work done – Potential function – surface integral –area, volume integral-volume- Vector integral theorems: Greens, Stokes and Gauss Divergence Theorems (Without proof) and related problems.

Application: work done, Force

BOOKS:

1. **GREENBERG,** Advanced Engineering Mathematics, 9th Edition, Wiley-India
2. **B.V. RAMANA,** Higher Engineering Mathematics, Tata McGrawhill
3. **ERWIN KREYSZIG,** Advanced Engineering Mathematics, 9th Edition, Wiley-India
4. **PETER O'NEIL,** Advanced Engineering Mathematics, Cengage Learning
5. **D.W. JORDAN AND T. SMITH,** Mathematical Techniques, Oxford University Press

Course outcomes:

After completion of the course student could be able to

- apply numerical methods to find the solutions of system of equations
- find eigenvalues and eigen vectors
- evaluate multiple and triple integrals and apply the concepts to find the physical quantities like surface areas and volumes of solids
- understand the importance of vector differential and integral calculus and interpret the physical and engineering concepts (electromagnetic theory, circuit theory etc) in an elegant way

Subject Category	ABET Learning Objectives	ABET Internal Assessments	JNTUK External Evaluation	Remarks
Theory Design Analysis Algorithms Drawing Others	a) Apply knowledge of math, science, & engineering b) Design & conduct experiments, analyze & interpret data c) Design a system/process to meet desired needs within economic, social, political, ethical, health/safety, manufacturability, & sustainability constraints d) Function on multidisciplinary teams e) Identify, formulate, & solve engineering problems f) Understand professional & ethical responsibilities g) Communicate effectively	1. Objective tests 2. Essay questions tests 3. Peer tutoring based 4. Simulation based 5. Design oriented 6. Problem based 7. Experiential (project based) based 8. Lab work or field work based 9. Presentation based 10. Case Studies based 11. Role-play based 12. Portfolio based	A. Questions should have: B. Definitions, Principle of operation or philosophy of concept. C. Mathematical treatment, derivations, analysis, synthesis, numerical problems with inference. D. Design oriented problems E. Trouble shooting type of questions F. Applications related questions	

	h) Understand impact of engineering solutions in global, economic, environmental, & societal context i) Recognize need for & be able to engage in lifelong learning j) Know contemporary issues k) Use techniques, skills, modern tools for engineering practices		G. Brain storming questions	

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ENGINEERING CHEMISTRY

UNIT-I: WATER TECHNOLOGY

Hard Water – Estimation of hardness by EDTA method – Potable water- Sterilization and Disinfection – Boiler feed water – Boiler troubles – Priming and foaming , scale formation, corrosion, caustic embrittlement, turbine deposits – Softening of water – Lime soda, Zeolite processes – Reverse osmosis – Electro Dialysis, Ion exchange process

Objectives: For prospective engineers knowledge about water used in industries (boilers etc.) and for drinking purposes is useful; hence chemistry of hard water, boiler troubles and modern methods of softening hard water is introduced.

UNIT-II: ELECTROCHEMISTRY

Concept of Ionic conductance – Ionic Mobilities – Applications of Kohlrausch law – Conductometric titrations – Galvanic cells – Electrode potentials – Nernst equation – Electrochemical series – Potentiometric titrations – Concentration cells – Ion selective electrode –Glass electrodes – Fluoride electrode; Batteries and Fuel cells

Objectives: Knowledge of galvanic cells, electrode potentials, and concentration cells is necessary for engineers to understand corrosion problem and its control; also this knowledge helps in understanding modern bio-sensors, fuel cells and improve them.

UNIT-III: CORROSION

Causes and effects of corrosion – theories of corrosion (dry, chemical and electrochemical corrosion) – Factors affecting corrosion – Corrosion control methods – Cathodic protection – Sacrificial Anodic, Impressed current methods – Surface coatings – Methods of application on metals (Hot dipping, Galvanizing, tinning , Cladding, Electroplating, Electroless plating) – Organic surface coatings – Paints – Their constituents and their functions.

Objectives: the problems associated with corrosion are well known and the engineers must be aware of these problems and also how to counter them

UNIT-IV: HIGH POLYMERS

Types of Polymerization – Stereo regular Polymers – Physical and Mechanical properties of polymers – Plastics – Thermoplastics and thermo setting plastics – Compounding and Fabrication of plastics – Preparation and properties of Polyethylene, PVC and Bakelite – Elastomers – Rubber and Vulcanization – Synthetic rubbers – Styrene butadiene rubber – Thiokol – applications.

Objectives: Plastics are materials used very widely as engineering materials. An understanding of properties particularly physical and mechanical properties of polymers / plastics / elastomers helps in selecting suitable materials for different purposes.

UNIT-V: FUELS

Coal – Proximate and ultimate analysis – Numerical problems based on analysis – Calorific value – HCV and LCV – Problems based on calorific values; petroleum – Refining – Cracking – Petrol – Diesel knocking; Gaseous fuels – Natural gas – LPG, CNG – Combustion – Problems on air requirements.

Objectives: A board understanding of the more important fuels employed on a large scale is necessary for all engineer to understand energy – related problems and solve them.

UNIT-VI: CHEMISTRY OF ADVANCED MATERIALS

Nanometerials (Preparation of carbon nanotubes and fullerenes – Properties of nanomaterials – Engineering applications) – Liquid crystals (Types – Application in LCD and Engineering Applications) – Fiber reinforced plastics – Biodegradable polymers – Conducting polymers – Solar cells (Solar heaters – Photo voltaic cells – Solar reflectors – Green house concepts – Green chemistry (Methods for green synthesis and Applications) – Cement – Hardening and setting – Deterioration of cement concrete

Objectives: With the knowledge available now, future engineers should know at least some of the advanced materials that are becoming available. Hence some of them are introduced here.

TEXT BOOKSS

1. Jain and Jain (Latest Edition), Engineering Chemistry, DhanpatRai Publishing company Ltd,
2. N.Y.S.Murthy, V.Anuradha, KRamaRao "A Text Book of Engineering Chemistry", Maruthi Publications
3. C.Parameswara Murthy, C.V.Agarwal, Adhra Naidu (2006) Text Book of Engineering Chemistry, B.S.Publications
4. B.Sivasankar (2010), Engineering Chemistry, McGraw-Hill companies.
5. Ch.VenkataRamana Reddy and Ramadevi (2013) , Engineering Chemistry, Cengage Learning

REFERENCES

1. S.S. Dara (2013) Text Book of Engineering Chemistry, S.Chand Technical Series
2. K.SeshaMaheswaramma and MridulaChugh (2013), Engineering Chemistry, Pearson Publications.
3. R.Gopalan, D.Venkatappayya, SulochanaNagarajan (2011), Text Book of Engineering Chemistry, Vikas Publications.
4. B.Viswanathan and M.AuliceScibioh (2009), Fuel Cells, Principals and applications, University Press.

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ENGINEERING MECHANICS

Objectives: The students completing this course are expected to understand the concepts of forces and its resolution in different planes,resultant of force system, Forces acting on a body, their free body diagrams using graphical methods. They are required to understand the concepts of centre of gravity and moments of inertia and their application, Analysis of frames and trusses, different types of motion, friction and application of work - energy method.

UNIT – I

Objectives: The students are to be exposed to the concepts of force and friction, direction and its application.

Introduction to Engg. Mechanics – Basic Concepts.

Systems of Forces: Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems. Introduction**,** limiting friction and impending motion, coulomb's laws of dry friction, coefficient of friction, cone of friction

UNIT II

Objectives: The students are to be exposed to application of free body diagrams. Solution to problems using graphical methods and law of triangle of forces.

Equilibrium of Systems of Forces: Free Body Diagrams, Equations of Equilibrium of Coplanar Systems, and Spatial Systems for concurrent forces. LamisTheorm, Graphical method for the equilibrium of coplanar forces, Converse of the law of Triangle of forces, converse of the law of polygon of forces condition of equilibrium.

UNIT – III

Objectives: The students are to be exposed to concepts of centre of gravity.

Centroid: Centroids of simple figures (from basic principles) – Centroids of Composite Figures

Centre of Gravity: Centre of gravity of simple body (from basic principles), centre of gravity of composite bodies, pappus theorem.

UNIT IV

Objective: The students are to be exposed to concepts of moment of inertia and polar moment of inertia including transfer methods and their applications.

Area moments of Inertia : Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia.

Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

UNIT – V

Objectives: The students are to be exposed to motion in straight line and in curvilinear paths, its velocity and acceleration computation and methods of representing plane motion.

Kinematics: Rectilinear and Curvelinear motions – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion. **Kinetics:** Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.

UNIT – VI

Objectives: The students are to be exposed to concepts of work, energy and particle motion

Work – Energy Method: Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method.

TEXT BOOKS:

1. Engg. Mechanics - S.Timoshenko&D.H.Young., 4thEdn - , McGraw Hill publications.
2. Engineering Mechanics: Statics and Dynamics 3rd edition, Andrew Pytel and JaanKiusalaas; Cengage Learning publishers.

REFERENCES:

1. Engineering Mechanics statics and dynamics – R.C.Hibbeler, 11thEdn – Pearson Publ.
2. Engineering Mechanics, statics – J.L.Meriam, 6thEdn – Wiley India Pvt Ltd.
3. Engineering Mechanics, dynamics – J.L.Meriam, 6thEdn – Wiley India Pvt Ltd.
4. Engineering Mechanics, statics and dynamics – I.H.Shames, – Pearson Publ.
5. Mechanics for Engineers, statics - F.P.Beer&E.R.Johnston – 5thEdnMcGraw Hill Publ.
6. Mechanics for Engineers, dynamics - F.P.Beer&E.R.Johnston – 5thEdnMcGraw Hill Publ.
7. Theory & Problems of engineering mechanics, statics & dynamics – E.W.Nelson, C.L.Best& W.G. McLean, 5thEdn – Schaum's outline series - McGraw Hill Publ.
8. Engineering Mechanics, Fedinand . L. Singer, Harper – Collins.
9. Engineering Mechanics statics and dynamics , A Nelson, McGraw Hill publications
10. Engineering Mechanics, Tayal. Umesh Publ.

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Computer Programming in C

Objectives:

Formulating algorithmic solutions to problems and implementing algorithms in C

UNIT I:
Unit objective: Notion of Operation of a CPU, Notion of an algorithm and computational procedure, editing and executing programs in Linux

Introduction: Computer systems, Hardware and Software Concepts**,**
Problem Solving: Algorithm / Pseudo code, flowchart, program development steps, computer languages: machine, symbolic and highlevel languages, Creating and Running Programs: Writing, Editing(vi/emacs editor), Compiling(gcc), Linking and Executing in under Linux.
BASICS OF C: Structure of a c program, identifiers, basic data types and sizes. Constants, Variables, Arthmetic , relational and logical operators, increment and decrement operators, conditional operator, assignment operator, expressions, type conversions, Conditional Expressions, precedence and order of evaluation, Sample Programs.

UNIT II:
Unit objective: understanding branching, iteration and data representation using arrays

SELECTION – MAKING DECISION: TWO WAY SELECTION: if-else, null else, nested if, examples, Multi-way selection: switch, else-if, examples**.**
ITERATIVE: loops- while, do-while and for statements , break, continue, initialization and updating, event and counter controlled loops, Looping applications: Summation, powers, smallest and largest.
ARRAYS: Arrays- concepts, declaration, definition, accessing elements, storing elements, Strings and String Manipulations, 1-D arrays, 2-Darrays and character arrays, string manipulations, Multidimensional arrays, array applications: Matrix operations, checking the symmetricity of a Matrix**.**
STRINGS: concepts, c strings.

UNIT III:
Objective: Modular programming and recursive solution formulation

FUNCTIONS- MODULAR PROGRAMMING: functions, basics, parameter passing, storage classes extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, Recursive solutions for fibonacci series, towers of Hanoi, header files, C Preprocessor, example c programs, Passing 1-D arrays, 2-D arrays to functions.

UNIT IV:
Objective: Understanding pointers and dynamic memory allocation

POINTERS: pointers- concepts, initialization of pointer variables, pointers and function arguments, passing by address- dangling memory, address arithmetic, character pointers and functions, pointers to pointers, pointers and multi-dimensional arrays, dynamic memory management functions, command line arguments

UNIT V:
Objective: Understaning miscellaneous aspects of C
ENUMERATED, STRUCTURE AND UNION TYPES: Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bit-fields, program applications
BIT-WISE OPERATORS: logical, shift, rotation, masks.

UNIT VI:
Objective: Comprehension of file operations
FILEHANDLING: Input and output- concept of a file, textfiles and binary files, Formatted I/O, File I/O operations, example programs

Text Books:

1. Problem Solving and Program Design in C, Hanly, Koffman, 7thed, PERSON
2. Programming in C, Second Edition PradipDey and Manas Ghosh, OXFORD Higher Education
3. Programming in C, A practical approach Ajay Mittal PEARSON
4. The C programming Language by Dennis Richie and Brian Kernighan
5. Programming in C , B L Juneja, Anita Seth, CENGAGE Leaning.

Reference Books and web links:

1. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE
2. Programming with C, Bichkar, Universities Press
3. Programming in C, ReemaThareja, OXFORD
4. C by Example, Noel Kalicharan, Cambridge

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ENVIRONMENTAL STUDIES

Course Learning Objectives:
The objectives of the course is to impart
1. Overall understanding of the natural resources
2. Basic understanding of the ecosystem and its diversity
3. Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities
4. An understanding of the environmental impact of developmental activities

5. Awareness on the social issues, environmental legislation and global treaties

Course Outcomes:
The student should have knowledge on
1. The natural resources and their importance for the sustenance of the life and recognise the need to conserve the natural resources
2. The concepts of the ecosystem and its function in the environment. The need for protecting the producers and consumers in various ecosystems and their role in the food web
3. The biodiversity of India and the threats to biodiversity, and conservation practices to protect the biodiversity
4. Various attributes of the pollution and their impacts and measures to reduce or control the pollution along with waste management practices
5. Social issues both rural and urban environment and the possible means to combat the challenges
6. The environmental legislations of India and the first global initiatives towards sustainable development.
7. About environmental assessment and the stages involved in EIA and the environmental audit

SYLLABUS:

UNIT - I
Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance – Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects. Role of information Technology in Environment and human health.
Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

UNIT - II
Natural Resources: Natural resources and associated problems
Forest resources – Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people

Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources
Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity
Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.
Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT - III
Biodiversity and its conservation: Definition: genetic, species and ecosystem diversity-classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.

UNIT - IV
Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies.
Solid Waste Management: Sources, classification,effects and control measures of urban and industrial solid wastes. Consumerism and waste products.

UNIT - V
Social Issues and the Environment: Urban problems related to energy -Water conservation, rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness.

UNIT - VI
Environmental Management: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism
The student should submit a report individually on any issues related to Environmental Studies course and make a power point presentation.

Text Books:
1. Environmental Studies by R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
2. A Textbook of Environmental Studies by Shaashi Chawla, TMH, New Delhi
3. Environmental Studies by P.N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

Reference:

1. Text Book of Environmental Studies by Deeshita Dave & P. UdayaBhaskar, Cengage Learning.
2. Environmental Studies by K.V.S.G. Murali Krishna, VGS Publishers, Vijayawada
3. Environmental Studies by Benny Joseph, Tata McGraw Hill Co, New Delhi
4. Environmental Studies by PiyushMalaviya, Pratibha Singh, Anoopsingh: Acme Learning, New Delhi

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ENGINEERING CHEMISTRY LABORATORY

List of Experiments

1. Introduction to chemistry laboratory – Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis, Quantitative analysis etc.,
2. Trial experiment – Estimation of HCI using standard Na_2co_3 solutions
3. Estimation of $KMnO_4$using standard Oxalic acid solution.
4. Estimation of Ferric iron using standard $K_2Cr_2O_7$ solution.
5. Estimation of Copper using standard $K_2Cr_2O_7$ solution.
6. Estimation of Total Hardness water using standard EDTA solution.
7. Estimation of Copper using standard EDTA solution.
8. Estimation of Copper using Colorimeter
9. Estimation of pH of the given sample solution using pH meter.
10. Conductometric Titrations between strong acid and strong base
11. Conductometric Titrations between strong acid and Weak base
12. Potentiometric Titrations between strong acid and strong base
13. Potentiometric Titrations between strong acid and Weak base
14. Estimatinog of Zinc using standard potassium ferrocyanide solution
15. Estimation of Vitamin – C

TEXT BOOKSS

1. Dr.JyotsnaCherukuis(2012)Laboratory Manual of Engineering Chemistry-II, VGS Techno Series
2. Chemistry Practical Manual, Lorven Publications
3. K. Mukkanti (2009) Practical Engineering Chemistry, B.S.Publication

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ENGLISH – COMMUNICATION SKILLS LAB – I

Suggested Lab Manuals:

OBJECTIVE: To impart to the learner the skills of grammar as well as communication through listening, speaking, reading, and writing including soft, that is life skills.

BASIC COMMUNICATION SKILLS

UNIT 1	A. Greeting and Introductions
	B. Pure Vowels
UNIT 2	A. Asking for information and Requests
	B. Diphthongs
UNIT 3	A. Invitations
	B. Consonants
UNIT 4	A. Commands and Instructions
	B. Accent and Rhythm
UNIT 5	A. Suggestions and Opinions
	B. Intonation

Text Book:

'Strengthen your Communication Skills' Part-A by Maruthi Publications

Reference Books:

1. INFOTECH English (Maruthi Publications)
2. Personality Development and Soft Skills (Oxford University Press, New Delhi)

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C Programming Lab

Exercise l

a) Write a C Program to calculate the area of triangle using the formula
area = (s (s-a) (s-b)(s-c))$^{1/2}$ where s= (a+b+c)/2
b) Write a C program to find the largest of three numbers using ternary operator.
c) Write a C Program to swap two numbers without using a temporary variable.

Exercise 2

a) 2's complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2's complement of 11100 is 00100. Write a C program to find the 2's complement of a binary number.
b) Write a C program to find the roots of a quadratic equation.
c) Write a C program, which takes two integer operands and one operator form the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)

Exercise 3

a) Write a C program to find the sum of individual digits of a positive integer and find the reverse of the given number.
b) A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
c) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

Exercise 4

a) Write a C Program to print the multiplication table of a given number n up to a given value, where n is entered by the user.
b) Write a C Program to enter a decimal number, and calculate and display the binary equivalent of that number.
c) Write a C Program to check whether the given number is Armstrong number or not.

Exercise 5

a) Write a C program to interchange the largest and smallest numbers in the array.
b) Write a C program to implement a liner search.
c) Write a C program to implement binary search

Exercise 6

a) Write a C program to implement sorting of an array of elements.
b) Write a C program to input two m x n matrices, check the compatibility and perform addition and multiplication of them

Exercise 7

Write a C program that uses functions to perform the following operations:

i. To insert a sub-string in to given main string from a given position.
ii. To delete n Characters from a given position in a given string.
iii. To replace a character of string either from beginning or ending or at a specified location

Exercise 8

Write a C program that uses functions to perform the following operations using Structure:

i) Reading a complex number ii) Writing a complex number
iii) Addition of two complex numbers iv) Multiplication of two complex numbers

Exercise 9

Write C Programs for the following string operations without using the built in functions

- to concatenate two strings
- to append a string to another string
- to compare two strings

Exercise 10

Write C Programs for the following string operations without using the built in functions

- to find the length of a string
- to find whether a given string is palindrome or not

Exercise 11

a) Write a C functions to find both the largest and smallest number of an array of integers.
b) Write C programs illustrating call by value and call by reference cncepts.

Exercise 12

Write C programs that use both recursive and non-recursive functions for the following

i) To find the factorial of a given integer.
ii) To find the GCD (greatest common divisor) of two given integers.
iii) To find Fibonacci sequence

Exercise 13

a) Write C Program to reverse a string using pointers
b) Write a C Program to compare two arrays using pointers

Exercise 14

a) Write a C program consisting of Pointer based function to exchange value of two integers using passing by address.
b) Write a C program to swap two numbers using pointers

Exercise 15

Examples which explores the use of structures, union and other user defined variables

Exercise 16

a) Write a C program which copies one file to another.
b) Write a C program to count the number of characters and number of lines in a file.
c) Write a C Program to merge two files into a third file. The names of the files must be entered using command line arguments.

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ENGLISH –II
(Common to All Branches)

DETAILED TEXT-II :Sure Outcomes: English for Engineers and Technologists
Recommended Topics :

1. **TECHNOLOGY WITH A HUMAN FACE**
   OBJECTIVE: To make the learner understand how modern life has been shaped by technology.
   OUTCOME: The proposed technology is people's technology. It serves the human person instead of making him the servant of machines.
2. **CLIMATE CHANGE AND HUMAN STRATEGY**
   OBJECTIVE: To make the learner understand how the unequal heating of earth's surface by the Sun, an atmospheric circulation pattern is developed and maintained.
   OUTCOME: The learner's understand that climate must be preserved.
3. **EMERGING TECHNOLOGIES**
   OBJECTIVE: To introduce the technologies of the 20th century and 21st centuries to the learners.
   OUTCOME: The learner will adopt the applications of modern technologies such as nanotechnology.
4. **WATER- THE ELIXIR OF LIFE**
   OBJECTIVE: To inform the learner of the various advantages and characteristics of water.
   OUTCOME: The learners will understand that water is the elixir of life.
5. **THE SECRET OF WORK**
   OBJECTIVE:**:**In this lesson, Swami Vivekananda highlights the importance of work for any development.
   OUTCOME: The students will learn to work hard with devotion and dedication.
6. **WORK BRINGS SOLACE**
   OBJECTIVE: In this lesson Abdul Kalam highlights the advantage of work.
   OUTCOME:The students will understand the advantages of work. They will overcome their personal problems and address themselves to national and other problems.

Text Book: 'Sure Outcomes' by Orient Black Swan Pvt. Ltd. Publishers

NON-DETAILED TEXT:

(From Modern Trailblazers of Orient Blackswan)
(Common single Text book for two semesters)
(Semester I (1 to 4 lessons)/ Semester II (5 to 8 lessons)

5. **J.C. Bose**
   OBJECTIVE: To apprise of J.C.Bose's original contributions.
   OUTCOME: The learner will be inspired by Bose's achievements so that he may start his own original work.
6. **HomiJehangirBhaba**
   OBJECTIVE: To show Bhabha as the originator of nuclear experiments in India.

OUTCOME: The learner will be inspired by Bhabha's achievements so as to make his own experiments.

7. **Vikram Sarabhai**
   OBJECTIVE: To inform the learner of the pioneering experiments conducted by Sarabhai in nuclear energy and relevance of space programmes.
   OUTCOME: The learner will realize that development is impossible without scientific research.
8. **A Shadow- R.K.Narayan**
   OBJECTIVE: To expose the reader to the pleasure of the humorous story
   OUTCOME: The learner will be in a position to appreciate the art of writing a short story and try his hand at it.

Text Book: 'Trail Blazers' by Orient Black Swan Pvt. Ltd. Publishers

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MATHEMATICS – II
(MATHEMATICAL METHODS)

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(Common to All Branches)

Course Learning Objectives:

The objectives of the course is to make the student understand how to

- apply numerical methods to obtain the roots of equations
- appy iterative schemes to solve initial value problems associated with ordinary differential equations
- express a given data points as a polynomial and a periodic function as a infinite series of orthonormal functions
- become competent enough to apply mathematical concepts in the Theory of signals and systems

UNIT I:Solution of Algebraic and Transcendental Equations:
Introduction- Bisection Method – Method of False Position – Iteration Method – Newton – Raphson Method (One variable and Simultaneous Equations)

UNIT II: Interpolation:
Introduction- Errors in Polynomial Interpolation – Finite differences- Forward Differences- Backward differences –Central differences – Symbolic relations and separation of symbols-Differences of a polynomial-Newton's formulae for interpolation – Interpolation with unevenly spaced points – Lagrange's Interpolation formula

UNIT III: Numerical solution of Ordinary Differential equations:
Solution by Taylor's series-Picard's Method of successive Approximations-Euler's Method-Runge-Kutta Methods

UNIT IV Fourier Series:
Introduction- Determination of Fourier coefficients – even and odd functions –change of interval– Half-range sine and cosine seriesapplication: Amplitude, spectrum of a periodic function

UNIT V: Fourier Transforms:
Fourier integral theorem (only statement) – Fourier sine and cosine integrals - sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms

UNIT VI:Z-transform:
Introduction– properties – Damping rule – Shifting rule – Initial and final value theorems -Inverse z transform- -Convolution theorem – Solution of difference equation by Z - transforms.

BOOKS:

1. **B.S. GREWAL,** HigherEngineering Mathematics, 42nd Edition, Khanna Publishers
2. **DEAN G. DUFFY,** Advanced Engineering Mathematics with MATLAB, CRC Press
3. **S.S.SASTRY,** Introductory methods of numerical analysis, PHI Publications
4. **V.RAVINDRANATH and P. VIJAYALAXMI,** Mathematical Methods, Himalaya Publishing House
5. **ERWYN KREYSZIG,** Advanced Engineering Mathematics, 9th Edition, Wiley-India

Course outcomes:

After completion of the course student could be able to

- Apply numerical methods for root finding and understand the importance of these
- methods in high dimensional engineering problems
- find an interpolating polynomial fitting a given points
- understand the importance of Fourier analysis in the fields of Electrical, Electronics, Computer science, Thermal dynamics etc

Subject Category	ABET Learning Objectives	ABET Internal Assessments	JNTUK External Evaluation	Remarks
Theory Design Analysis Algorithms Drawing Others	a) Apply knowledge of math, science, & engineering b) Design & conduct experiments, analyze & interpret data c) Design a system/process to meet desired needs within economic, social, political, ethical, health/safety, manufacturability, & sustainability constraints d) Function on multidisciplinary teams e) Identify, formulate, & solve engineering problems f) Understand professional & ethical responsibilities g) Communicate effectively h) Understand impact of engineering solutions in global, economic, environmental, & societal context i) Recognize need for & be able to engage in lifelong learning j) Know contemporary issues k) Use techniques, skills, modern tools for engineering practices	1. Objective tests 2. Essay questions tests 3. Peer tutoring based 4. Simulation based 5. Design oriented 6. Problem based 7. Experiential (project based) based 8. Lab work or field work based 9. Presentation based 10. Case Studies based 11. Role-play based 12. Portfolio based	A. Questions should have: B. Definitions, Principle of operation or philosophy of concept. C. Mathematical treatment, derivations, analysis, synthesis, numerical problems with inference. D. Design oriented problems E. Trouble shooting type of questions F. Applications related questions G. Brain storming questions	

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MATHEMATICS – III
(LINEAR ALGEBRA & VECTOR CALCULUS)
(Common to All Branches)

T	P	C
3+1	0	3

Course Learning Objectives:

The objectives of the course is to make the student understand the

- importance of matrix methods in high dimensional engineering problems (ex.: Electrical circuits) and finding the solutions of system of equations
- integral calculus over regions in plane and space and applications to area and volumes
- analyze and solve the engineering problems in mathematical aspect and interpret the solutions in terms of the actual problem

UNIT I: Linear systems of equations:

Rank-Echelon form, Normal form – Solution of Linear Systems – Direct Methods- Gauss Elimination - Gauss Jordon and Gauss Seidal Methods.
Application: Finding the current in an electrical circuit.

UNIT II: Eigen values - Eigen vectors and Quadratic forms:

Eigen values - Eigen vectors– Properties –Iteration method to find largest eigen value and eigen vectors -Cayley-Hamilton Theorem - Inverse and powers of a matrix by using Cayley-Hamilton theorem Quadratic forms- Reduction of quadratic form to canonical form – Rank - Positive, negative definite - semi definite - index – signature.
Application: Free vibration of a two-mass system.

UNIT III:Multiple integrals:

Review concepts of Curve tracing (Cartesian - Polar and Parametric curves)-
Applications of Integration to Lengths, and Surface areas of revolution in Cartesian and Polar Coordinates.
Multiple integrals - double and triple integrals – change of variables – Change of order of Integration
Application: Areas of surfaces and volumes of solids,Moments of inertia.

UNIT IV:Special functions:

Beta and Gamma functions- Properties - Relation between Beta and Gamma functions
Application: Evaluation ofimproper integrals

UNIT V: Vector Differentiation:

Gradient- Divergence- Curl - Laplacian and second order operators -Vector identities
Application: Equation of continuity, potential surfaces,irrotational fields, potential functions

UNIT VI: Vector Integration:

Line integral – work done – Potential function – surface integral –area, volume integral-volume- Vector integral theorems: Greens, Stokes and Gauss Divergence Theorems (Without proof) and related problems.
Application: work done, Force

BOOKS:

1. **GREENBERG,** Advanced Engineering Mathematics, 9th Edition, Wiley-India
2. **B.V. RAMANA,** Higher Engineering Mathematics, Tata McGrawhill
3. **ERWIN KREYSZIG,** Advanced Engineering Mathematics, 9th Edition, Wiley-India
4. **PETER O'NEIL,** Advanced Engineering Mathematics, Cengage Learning
5. **D.W. JORDAN AND T. SMITH,** Mathematical Techniques, Oxford University Press

Course outcomes:

After completion of the course student could be able to

- apply numerical methods to find the solutions of system of equations
- find eigenvalues and eigen vectors
- evaluate multiple and triple integrals and apply the concepts to find the physical quantities like surface areas and volumes of solids
- understand the importance of vector differential and integral calculus and interpret the physical and engineering concepts (electromagnetic theory, circuit theory etc) in an elegant way

Subject Category	ABET Learning Objectives	ABET Internal Assessments	JNTUK External Evaluation	Remarks
Theory Design Analysis Algorithms Drawing Others	a) Apply knowledge of math, science, & engineering b) Design & conduct experiments, analyze & interpret data c) Design a system/process to meet desired needs within economic, social, political, ethical, health/safety, manufacturability, & sustainability constraints d) Function on multidisciplinary teams e) Identify, formulate, & solve engineering problems f) Understand professional & ethical responsibilities g) Communicate effectively h) Understand impact of engineering solutions in global, economic, environmental, & societal context i) Recognize need for & be able to engage in lifelong learning j) Know contemporary issues k) Use techniques, skills, modern tools for engineering practices	1. Objective tests 2. Essay questions tests 3. Peer tutoring based 4. Simulation based 5. Design oriented 6. Problem based 7. Experiential (project based) based 8. Lab work or field work based 9. Presentation based 10. Case Studies based 11. Role-play based 12. Portfolio based	A. Questions should have: B. Definitions, Principle of operation or philosophy of concept. C. Mathematical treatment, derivations, analysis, synthesis, numerical problems with inference. D. Design oriented problems E. Trouble shooting type of questions F. Applications related questions G. Brain storming questions	

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ENGINEERING PHYSICS

UNIT-I
PHYSICAL OPTICS FOR INSTRUMENTS
"Objective Designing an instrument and enhancing the resolution for its operation would be effective as achieved through study of applicational aspects of physical Optics"
INTERFACE : Introduction – Interference in thin films by reflection – Newton's rings.
DIFFRACTION : Introduction – Fraunhofer diffraction - Fraunhofer diffraction at double slit (qualitative) – Diffraction grating – Grating spectrum – Resolving power of a grating – Rayleigh's criterion for resolving power.
POLARIZATION : Introduction – Types of Polarization – Double refraction – Quarter wave plate ad Half Wave plate.

UNIT-II
COHERENT OPTICS – COMMUNICATIONS AND STRUCTURE OF MATERIALS
Objectives while lasers are trusted Non-linear coherent sources established for the fitness of instrumentation, establishing a structure property relationship for materials requires allotment of an equivalent footing in convening the physics knowledge base.
LASERS: Introduction – coherent sources – Characteristics of lasers – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion – Three and Four level pumping schemes – Ruby laser – Helium Neon laser.
FIBER OPTICS : Introduction – Principle of Optical Fiber – Acceptance angle and acceptance cone – Numerical aperture.
CRYSTALLOGRAPHY : Introduction – Space lattice – Basis – Unit Cell – Lattice parameters – Bravais lattices – Crystal systems – Structures and packing fractions of SC,BCC and FCC
X-RAY DIFFRACTION TECHNIQUES : Directions and planes in crystals – Miller indices – Separation between successive [h k l] planes – Bragg's law.

UNIT-III
MAGNETIC, ELECTRIC FIELD RESPONSE OF MATERIALS & SUPERCONDUCTIVITY
"Objective many of the Electrical or Electronic gadgets are designed basing on the response of naturally abundant and artificially made materials, while their response to E- or H- fields controls their performance.
MAGNETIC PROPERTIES : Magnetic permeability – Magnetization – Organ or magnetic moment – Classification of Magnetic materials – Dir, para, Ferro, anti ferro and ferri-magnetism – Hysteresis curve
DIELECTRIC PROPERTIES : Introduction – Dielectric constant – Electronic, ionic and orientational polarization – internal fields – Clausius – Mossotti equation – Dielectric loss, Breakdown and Strength.
SUPERCONDUCTIVITY : General properties – Meissner effect – Type I and Type II superconductors – BCS Theory Flux quantization London's equations – Penetration depth – DC and AC Josephson effects – SQUIDS.

UNIT – IV
ACOUSTICS AND EM – FIELDS:
Objective: The utility and nuances of ever pervading SHM and its consequences would be the first hand-on to as it clearly conveyed through the detailed studies of Acoustics of Buildings, while vectorial concepts of EM fields paves the student to gear – up for a deeper understanding.
ACOUSTICS: Sound absorption, absorption coefficient and its measurements, Reverberations time – Sabine's formula, Eyring's formula.

ELECTRO-MAGNETIC FIELDS: Gauss and stokes theorems (qualitative) – Fundamental laws of electromagnetism – Maxwell's Electromagnetic Equations (Calculus approach).

UNIT – V

QUANTUM MECHANICS FOR ELECTRONIC TRANSPORT

Objective: The discrepancy between classical estimates and laboratory observations of physical properties exhibited by materials would be lifted out through the understanding quantum picture of sub-atomic world dominated by electron and its presence.

QUANTUM MECHANICS: Introduction to matter waves – Schrodinger Time Independent and Time Dependent wave equations – Particle in a box.

FREE ELECTRON THEORY: Classical free electron theory – electrical conductivity – Mean free path – Relaxation time and drifty velocity – Quantum free electron theory – Fermi – Dirac (analytical) and its dependence on temperature – Fermi energy – density of states – derivations for current density.

BAND THEORY OF SOLIDS: Bloch theorem (qualitative) – Kronig – Penney model – Origin of energy band formation in solids – Classification of materials into conductors, semi – conductors & insulators – Concepts of effective mass of electron - concept of hole.

UNIT – VI

SEMICONDUCTOR PHYSICS:

Objective: In the wake of ever increasing demand for the space and power the watch word "small is beautiful", understanding the physics of electronic transport as underlying mechanism for appliances would provide a knowledge base.

Introduction – Intrinsic semiconductor and carrier concentration – Equation for conductivity – Extrinsic semiconductor and carrier concentration – Drift and diffusion – Einstein's equation – Hall Effect – direct & indirect band gap semiconductors – Electronic transport Mechanism for LEDs, Photo conductors and solar cells.

TEXT BOOKS

1. Solid state Physics by A.J. Dekker (Mc Millan India Ltd)
2. A text book of Engineering Physics by M.N. Avadhanulu& P.G. Kshirasagar (S. Chand publications)
3. Engineering Physics b;y M.R. Srinivasan (New Age international publishers)

REFERENCE BOOKS

1. 'Introduction to solid state physics' by Charles Kittle (Willey India Pvt.Ltd)
2. 'Applied Physics' by T. Bhimasenkaram (BSP BH Publications)
3. 'Applied Physics' by M.Arumugam (Anuradha Agencies)
4. 'Engineering Physics' by Palanisamy (Scitech Publishers)
5. 'Engineering Physics' by D.K.Bhattacharya (Oxford University press)
6. 'Engineering Physics' by Mani Naidu S (Pearson Publications)
7. 'Engineering Physics' by Sanjay D Jain and Girish G Sahasrabudhe (University Press)
8. 'Engineering Physics' by B.K.Pandey& S. Chaturvedi (Cengage Learning)

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Professional Ethics and Human Values

UNITI : Human Values:
Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value time – Co-operation – Commitment – Empathy – Self-confidence – Spirituality- Character.

UNITII : Engineering Ethics:
The History of Ethics-Purposes for Engineering Ethics-Engineering Ethics-Consensus and Controversy –Professional and Professionalism –Professional Roles to be played by an Engineer –Self Interest, Customs and Religion-Uses of Ethical Theories-Professional Ethics-Types of Inquiry – Engineering and Ethics-Kohlberg's Theory – Gilligan's Argument –Heinz's Dilemma.

UNITIII : Engineering as Social Experimentation:
Comparison with Standard Experiments – Knowledge gained – Conscientiousness – Relevant Information – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Accountability – Role of Codes – Codes and Experimental Nature of Engineering.

UNITIV : Engineers' Responsibility for Safety and Risk:
Safety and Risk, Concept of Safety – Types of Risks – Voluntary v/s Involuntary Risk- Short term v/s Long term Consequences- Expected Probability- Reversible Effects- Threshold Levels for Risk- Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.

UNITV : Engineers' Responsibilities and Rights:
Collegiality-Techniques for Achieving Collegiality –Two Senses of Loyalty-obligations of Loyalty-misguided Loyalty – professionalism and Loyalty- Professional Rights –Professional Responsibilities – confidential and proprietary information-Conflict of Interest-solving conflict problems – Self-interest, Customs and Religion- Ethical egoism-Collective bargaining-Confidentiality-Acceptance of Bribes/Gifts-when is a Gift and a Bribe-examples of Gifts v/s Bribes-problem solving-interests in other companies-Occupational Crimes-industrial espionage-price fixing-endangering lives- Whistle Blowing-types of whistle blowing-when should it be attempted-preventing whistle blowing.

UNITVI : Global Issues:
Globalization- Cross-culture Issues-Environmental Ethics-Computer Ethics-computers as the instrument of Unethical behaviour-computers as the object of Unethical Acts-autonomous computers-computer codes of Ethics-Weapons Development-Ethics and Research-Analysing Ethical Problems in Research-Intellectual Property Rights.

Text Books:

1. "Engineering Ethics and Human Values" by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009
2. "Professional Ethics and Morals" by Prof.A.R.Aryasri, DharanikotaSuyodhana-Maruthi Publications
3. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran- Laxmi Publications
4. "Professional Ethics and Human Values" by Prof.D.R.Kiran-
5. "Indian Culture, Values and Professional Ethics" by PSR Murthy-BS Publication
6. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill – 2003.
7. "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

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ENGINEERING DRAWING

Objective: Engineering drawing being the principle method of communication for engineers, the objective to introduce the students, the techniques of constructing the various types of polygons, curves and scales. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

UNIT I
Objective: The objective is to introduce the use and the application of drawing instruments and to make the students construct the polygons, curves and various types of scales. The student will be able to understand the need to enlarge or reduce the size of objects in representing them.
Polygons, Construction of regular polygons using given length of a side; Ellipse, arcs of circles and Oblong methods; Scales – Vernier and Diagonal scales.

UNIT II
Objective: The objective is to introduce orthographic projections and to project the points and lines parallel to one plane and inclined to other.
Introduction to orthographic projections; projections of points; projections of straight lines parallel to both the planes; projections of straight lines – parallel to one plane and inclined to the other plane.

UNIT III
Objective: The objective is to make the students draw the projections of the lines inclined to both the planes.
Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclinations and traces.

UNIT IV
Objective: The objective is to make the students draw the projections of the plane inclined toboth the planes.
Projections of planes: regular planes perpendicular/parallel to one plane and inclined to the other reference plane; inclined to both the reference planes.

UNIT V
Objective: The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the planes.
Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the planes.

UNIT VI
Objective: The objective is to represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view and vice versa.
Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

TEXT BOOKS:

1. Engineering Drawing by N.D. Butt, Chariot Publications
2. Engineering Drawing by K.L.Narayana& P. Kannaiah, Scitech Publishers.
3. Engineering Graphics by PI Varghese, McGrawHill Publishers

REFERENCE BOOKS:

1. Engineering Graphics for Degree by K.C. John, PHI Publishers
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers
3. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

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ENGLISH – COMMUNICATION SKILLS LAB – II

Suggested Lab Manuals:

OBJECTIVE: To impart to the learner the skills of grammar as well as communication through listening, speaking, reading, and writing including soft, that is life skills.

ADVANCED COMMUNICATION SKILLS

UNIT 6	Body language
UNIT 7	Dialogues
UNIT 8	Interviews and Telephonic Interviews
UNIT 9	Group Discussions
UNIT 10	Presentation Skills
UNIT 11	Debates

Text Book:

'Strengthen your Communication Skills' Part-B by Maruthi Publications

Reference Books:

1. INFOTECH English (Maruthi Publications)
2. Personality Development and Soft Skills (Oxford University Press, New Delhi)

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T	P	C
0	3	2

ENGINEERING PHYSICS LAB

List of Experiments

1. Determination of wavelength of a source-Diffraction Grating-Normal incidence
2. Newton's rings –Radius of Curvature of Plano_Convex Lens.
3. Determination of thickness of a thin object using parallel interference fringes.
4. Determination of Rigidity modulus of a material- Torsional Pendulum.
5. Determination of Acceleration due to Gravity and Radius of Gyration- Compound Pendulum.
6. Melde's experiment – Transverse and Longitudinal modes.
7. Verification of laws of stretched string – Sonometer.
8. Determination of velocity of sound – Volume resonator.
9. L C R Senes Resonance Circuit
10. Study of I/V Characteristics of Semiconductor diode
11. I/V characteristics of Zener diode
12. Thermistor characteristics – Temperature Coefficient
13. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus.
14. Energy Band gap of a Semiconductor p.n junction.
15. Hall Effect for semiconductor.

REFERENCE:

1. Engineering Physics Lab Manual by Dr.Y. Aparna&Dr.K.Venkateswarao (V.G.S.Book links)
2. Physics practical manual, Lorven Publications.

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T	P	C
0	3	2

Engineering Physics
Virtual Labs - Assignments

List of Experiments

1. Hall Effect
2. Crystal Structure
3. Hysteresis
4. Brewster's angle
5. Magnetic Levitation / SQUID
6. Numerical Aperture of Optical fiber
7. Photoelectric Effect
8. Simple Harmonic Motion
9. Damped Harmonic Motion
10. LASER – Beam Divergence and Spot size

URL : WWW.vlab.co.in

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T	P	C
0	3	2

ENGINEERING WORKSHOP & IT WORKSHOP

ENGINEERING WORKSHOP:

Course Objective: To impart hands-on practice on basic engineering trades and skills.
Note: At least two exercises to be done from each trade.

Trade:

Carpentry	1. T-Lap Joint
	2. Cross Lap Joint
	3. Dovetail Joint
	4. Mortise and Tennon Joint
Fitting	1. Vee Fit
	2. Square Fit
	3. Half Round Fit
	4. Dovetail Fit
Black Smithy	1. Round rod to Square
	2. S-Hook
	3. Round Rod to Flat Ring
	4. Round Rod to Square headed bolt
House Wiring	1. Parallel / Series Connection of three bulbs
	2. Stair Case wiring
	3. Florescent Lamp Fitting
	4. Measurement of Earth Resistance
Tin Smithy	1. Taper Tray
	2. Square Box without lid
	3. Open Scoop
	4. Funnel

IT WORKSHOP:

Objectives:

Enabling the student to understand basic hardware and software tools through practical exposure

PC Hardware:

Identification of basic peripherals, assembling a PC, installation of system software like MS Windows, device drivers. Troubleshooting Hardware and software _ some tips and tricks.

Internet & World Wide Web:

Different ways of hooking the PC on to the internet from home and workplace and effectively usage of the internet, web browsers, email, newsgroups and discussion forums .Awareness of cyber hygiene(protecting the personal computer from getting infected with the viruses), worms and other cyber attacks .

Productivity tools Crafting professional word documents; excel spread sheets, power point presentations and personal web sites using the Microsoft suite of office tools

(Note: Student should be thoroughly exposed to minimum of 12 Tasks)

PC Hardware

Task 1:Identification of the peripherals of a computer.

To prepare a report containing the block diagram of the CPU along with the configuration of each peripheral and its functions. Description of various I/O Devices

Task 2(Optional): A practice on disassembling the components of a PC and assembling them to back to working condition.

Task 3: Examples of Operating systems- DOS, MS Windows,Installation of MS windows on a PC.

Task 4: Introduction to Memory and Storage Devices, I/O Port, Device Drivers, Assemblers, Compilers, Interpreters, Linkers, Loaders.

Task 5:

Hardware Troubleshooting (Demonstration):

Identification of a problem and fixing a defective PC(improper assembly or defective peripherals).

Software Troubleshooting (Demonstration): Identification of a problem and fixing the PC for any software issues

Internet & Networking Infrastructure

Task 6: Demonstrating Importance of Networking, Transmission Media, Networking Devices-Gateway, Routers, Hub, Bridge, NIC,Bluetooth Technology, Wireless Technology, Modem, DSL, and Dialup Connection.

Orientation & Connectivity Boot Camp and web browsing: Students are trained to configure the network settings to connect to the Internet. They are trained to demonstrate the same through web browsing (including all tool bar options) and email access.

Task 7: **Search Engines & Netiquette:**

Students are enabled to use search engines for simple search, academic search and any other context based search (Bing, Google etc). Students are acquainted to the principles of micro-blogging, wiki, collaboration using social networks, participating in online technology forums

Task 8: Cyber Hygiene (Demonstration): Awareness of various threats on the internet. Importance of security patch updates and anti-virus solutions. Ethical Hacking, Firewalls, Multi-factor authentication techniques including Smartcard, Biometrics are also practiced

Word

Task 9: MS Word Orientation:

Accessing, overview of toolbars, saving files, Using help and resources, rulers, formatting ,Drop Cap , Applying Text effects, Using Character Spacing, OLE in Word, using templates, Borders and Colors, Inserting Header and Footer, Using Date and Time option, security features in word, converting documents while saving

Task 10: Creating project : Abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check , Track Changes, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes and Paragraphs.

Excel

Task 11: Using spread sheet features of EXCEL including the macros, formulae, pivot tables, graphical representations

Creating a Scheduler - Features to be covered:- Gridlines, Format Cells, Summation, auto fill, Formatting Text

LOOKUP/VLOOKUP

Task 12: Performance Analysis - Features to be covered:- Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

Power Point

Task 13: Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered during this week includes :- PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows, Hyperlinks, Inserting –Images, Clip Art, Tables and Charts in Powerpoint.

Task 14: Focusing on the power and potential of Microsoft power point. Helps them learn best practices in designing and preparing power point presentation. Topic covered during this week includes: - Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), Inserting – Background, textures, Design Templates, Hidden slides, OLE in PPT.

TEXT BOOK:

Faculty to consolidate the workshop manuals using the following references

1 Computer Fundamentals, Anita Goel, Pearson
2 Scott Mueller's Upgrading and Repairing PCs, 18/e, Scott. Mueller, QUE, Pearson,2008
3 Information Technology Workshop,3e, G Praveen Babu, M V Narayana BS Publications.
4 Comdex Information Technology, Vikas Gupta, dreamtech.

REFERENCE BOOK:

1. PC hardware Trouble shooting made easy, TMH
2. Essential Computer and IT Fundamentals for Engineering and Science Students, Dr. N.B. Venkateswarlu

R – 13: Petroleum Engineering
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COMPLEX VARIBLES

UNIT - I
Functions of a complex variable:
Introduction -Continuity – Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesian and polar coordinates. Harmonic and conjugate harmonic functions – Milne – Thompson method
Applications: Potential between parallel plates, coaxial cylinders, potential in angular regions

Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT - II
Elementary functions:
Exponential, trigonometric, hyperbolic functions and their properties – General power Z (c is complex), principal value.

Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 6
JNTUK External Evaluation A B

UNIT - III
Complex integration:
Line integral – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula -Liouville Theorem - Morera's Theorem
Applications: Circulation along closed curve, conservative fields

Subject Category
ABET Learning Objectives a e k
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT - IV
Power series:
Radius of convergence – Taylor's series,-Maclaurin's series -Laurent series- Singular point – Isolated singular point – pole of order m – essential singularity.

Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT - V

Residue theorem and applications

Residue- Residue theorem

Applications: Evaluation of integrals of the type (a) $\int_{-\infty}^{\infty} f(x)dx$

(b) $\int_{c}^{c+2\pi} f(cos\theta, sin\theta)d\theta$

(c) $\int_{-\infty}^{\infty} e^{imx} f(x)dx$

(d) Integrals by identation

Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT - VI

Conformal mapping:

Transformation by exp z, ln z, z^2, z ^n (n positive integer), Sin z, cos z, z + a/z. Translation, rotation, inversion and bilinear transformation – fixed point – cross ratio – properties – invariance of circles

Application: Potential between Noncoaxial cylinders, Flow around a corner

Subject Category
ABET Learning Objectives a e k
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, Wiley 2011.
2. Michael Greenberg, Advanced Engineering Mathematics, International Edition, Pearson, 1998.
3. Grewal, B. S., Higher Engineering Mathematics, Khanna Publishers, 2012.

Reference Books:

1. John H. Mathews, Russell W. Howell, Complex Analysis for Mathematics and Engineering, 5th Edition, Jones and Bartlett Publishers, 2006.
2. Saff, E. B and A. D. Snider, Fundamentals of Complex Analysis, 3rd Edition, Pearson, 2003.
3. Dennis G. Zill and Patrick Shanahan, A First course in Complex Analysis with Application, Jones and Bartlett Publishers, 2011.

Subject Category	**ABET Learning Objectives**	**ABET Internal Assessments**	**JNTUK External Evaluation**	**Remarks**
Theory Design Analysis Algorithms Drawing Others	l) Apply knowledge of math, science, & engineering m) Design & conduct experiments, analyze & interpret data n) Design a system/process to meet desired needs within economic, social, political, ethical, health/safety, manufacturability, & sustainability constraints o) Function on multidisciplinary teams p) Identify, formulate, & solve engineering problems q) Understand professional & ethical responsibilities r) Communicate effectively s) Understand impact of engineering solutions in global, economic, environmental, & societal context t) Recognize need for & be able to engage in lifelong learning u) Know contemporary issues v) Use techniques, skills, modern tools for engineering practices	13. Objective tests 14. Essay questions tests 15. Peer tutoring based 16. Simulation based 17. Design oriented 18. Problem based 19. Experiential (project based) based 20. Lab work or field work based 21. Presentation based 22. Case Studies based 23. Role-play based 24. Portfolio based	H. Questions should have: I. Definitions, Principle of operation or philosophy of concept. J. Mathematical treatment, derivations, analysis, synthesis, numerical problems with inference. K. Design oriented problems L. Trouble shooting type of questions M. Applications related questions N. Brain storming questions	

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech Petroleum Engineering – I Semester.

GENERAL GEOLOGY

- **Learning Objectives:** This basic course in general geology is designed to train the studentstounderstand the basics of geology, viz: formation of earth, layers of earth, different types of rocks, formation of sedimentary basins and the micro fossils and their relationship to oil and gas.
- expose the students to different geological environments relates to petroleum industry.

UNIT-I:
Dimensions of earth, structure, composition and origin of earth-envelops of the Earth- crust, mantle, core. Internal dynamic process- Plate tectonics- continental drift, Earthquake and volcanoes. External dynamic process- weathering, erosionand deposition.

UNIT-II:
Fundamental concepts in Geomorphology-geomorphic processes distribution of landforms-drainage patterns –development, Landforms in relation to rocks types, paleochannels, buried channels.

UNIT-III:
Geological work of rivers, wind, Ocean and glaciers and the landforms created by them.

UNIT-IV:
Origin of igneous,sedimentary and metamorphic rocks. Sedimentary structures-petrographic character of conglomerate, sandstone, shale, limestones.

UNIT-V:
Introduction to sedimentary basins and deltaic systems. Topographic maps, thematic maps, Topographic and thematic profiles.

UNIT-VI:
Paleontology: Introduction to Paleontology, Fossils and Fossilization.
Micropaleontology - Palynology: Distribution of microfossils-Foraminifera, Radiolaria, Conodonts, Ostracodes, Diatoms. Importance of micro fossils in oil exploration.

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

- discern the dimension of earth structure, composition, origin of earth, formation of earth. It deals essence of scientific studies dealing with the origin, age, structure of the earth and with the evolution, modification, and extinction of various surface and subsurface physical features.
- understand the land forms as geomorphology, physiography and to gain a better perspective conforming to the present day thinking on the aspects of geology.
- be impressed by the fact that the subject is not static and will more likely keep his mind open to new ideas.

- understand the origin of different kinds of igneous, sedimentary, metamorphic rocks that can be understood in terms of their tectonic setting.
- gain the knowledge on fundamentals of sedimentary basins and paleontology and their significance to the petroleum industry.

Text Books:

1. Bell, F.G., Engineering Geology, 2nd Edition,ButterworthHeimann,2007.
2. Mukharje, P.K., Text book of Geology, P.K The World Press PvtLtd., 2005.

Reference Books:

1. Gribble, C. D., Rutley's Elements of Mineralogy, 27th Edition. CBS Publishers, 2005.
2. David Duff, Homes' Principles of Physical Geology, Nelson Thornes Ltd; 4th Revised edition, 1992.
3. Mahapatra, G.B., Text Book of Physical Geology, CBS Publishers, 2002.
4. Bangar, K.M., Principles of Engineering Geology, 2nd Edition, Standard Publishers, 2009.

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech Petroleum Engineering – I Semester.

SURVEYING AND OFFSHORE STRUCTURES

Learning Objectives: The students will be trained to

- demonstrate the principles of surveying for the measurement of distance and angles.
- explain the concepts of leveling and contouring.
- introduce the concepts of advanced surveying and implementation in shoreline surveying.
- demonstrate the principles of sea surveying.
- introduce the concepts of wave and current data collection.
- explain various stages of fixed offshore structure in view of the operation.
  introduce the concept and types of compliant structures.
- demonstrate the basic terminology and floatation principles of floating structures.

UNIT – I

Distance and Direction: Objectives, Principles and classifications of Surveying, chain, tape, Electronic distance measurements, Meriadians Azimuths and Barings, declination, computation of angle.

Theodolite: Theodolite, description, uses and adjustments – temporary, measurement of horizontal and vertical angles. Principles of Electronic Theodolite.

UNIT – II

Leveling and Contouring: Concept and Terminology, Temporary- method of leveling. Characteristics and Uses of contours- methods of conducting contour surveys and their plotting.

UNIT -III

Introduction to Advanced Surveying: Total Station and Global positioning system
HYDROGRAPHIC SURVEYING: Introduction- Shoreline Surveys- Sounding Methods.

UNIT –IV

Subsea surveying and geomatics, introduction to the principles of subsea surveying and geomatics including bathymetry and seismic survey, positioning systems (surface positioning, visual positioning techniques) distance from shore & water depth, generation of surface waves in oceans, wave data collection, current data collection.

UNIT –V

Functions of offshore structures, fixed offshore structures, types of fixed structures, fabrication, transportation, installation and operation of offshore structures, construction of offshore concrete structures, definition of compliant structures, types of complaint structures.

UNIT –VI

Floating structures, basic hydrostatics, centre of gravity, center of buoyancy, displacement, law of floatation, draft, keel, Simpson's rule for areas and centroids, second moments of area, moments of inertia, mass moment of inertia, calculation of metacentric height, stability of floating structures, definition of neutrally and positively buoyant structures.

Outcomes: After successful completion of the course, the student can understand

- the basic principles and significance of measurement of distance and direction
- horizontal and vertical angles
- principles, importance and measurement of angles using Theodolite
- concepts and terminology in contour mapping
- measurement and to plotting the contour maps
- basics of total station and GPS
- shore line survey and basics of acoustics, application in the field.
- basics of sea surveying and bathymetry, importance of bathymetry survey, seismic survey, positioning and wave and current data collection and significance of data collection.
- types and functions of fixed offshore structures, methodology of fabrication transportation, installation and operation of fixed offshore structures, Significance and types of compliant structures.
- the basic principles of floatation and stability of floating structures.
- stability criteria of neutrally and positively buoyant structures.

Text Books for Units I-III

1. Punmia, B.C., Ashok Kumar Jain and Arun Kumar Jain , Surveying (Vol – 1, 2) ; Higher Surveying, Vol 3, Laxmi Publications, 2005.
2. Duggal S K, Surveying (Vol – 1 & 2), Tata McGraw Hill, 2004.
3. Venkataramaiah, C., Text book of Surveying, Universities Press, 1996.

Text Books for Units IV-VI

1. Subrata K. Chakrabarti, Handbook of Offshore Engineering, Volume 1, Elsevier, 2005.
2. Barrass, C. B. and D. R. Derret, Ship Stability for Masters and Mates, 7th Edition, Butterworth-Heinemann, 2012.
3. Gerwick, Jr., C., Construction of Marine and Offshore Structure, 3rd Edition, CRC Press, 2007

Reference Books for Units IV-VI

1. Faltinsen, O., Sea Loads on Ships and Offshore Structures, Cambridge University Press, 1993
2. Dean, E. T. R., Offshore Geotechnical Engineering: Principles and Practice, ICEP, 2009
3. Paik, J. M., and T. Anil Kumar, Ship-Shaped Offshore Installations: Design, Building and Operation, Cambridge University Press, 2007
4. Yong Bai and QiangBai, Subsea Engineering Handbook, (Chapter 4), Gulf Professional Publishing, 2012
5. Mohamed A. EL-Reedy, Offshore Structures, Design, Construction and Maintenance, Gulf Professional Publishing

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech. Petroleum Engineering – I Semester.

ELEMENTS OF MECHANICAL ENGINEERING

Learning Objectives: The content of this course shall provide the student the basic concepts of various mechanical systems and exposes the student to a wide range of equipment and their utility in a practical situation. It shall provide the fundamental principles of materials, fuels, Steam, I.C.Engines, compressors, hydraulic machines and transmission systems that usually exist in any process plant.

UNIT –I:
Stresses and strains: kinds of – stress-strains, elasticity and plasticity, Hooks law, stress –strain diagrams, modules of elasticity, Poisson's ratio, linear and volumetric strain, relation between E, N, and K, bars of uniform strength, compound bars and temperature stresses.

UNIT– II:
Types of supports – loads – Shear force and bending moment for cantilever and simply supported beams without overhanging for all types of loads.
Theory of simple bending, simple bending formula,Distribution of Flexural and Shear stress in Beam section – Shear stress formula – Shear stress distribution for some standard sections
UNIT-III:
Thin cylindrical shells: stress in cylindrical shells due to internal pressures, circumferential stress, longitudinal stress, design of thin cylindrical shells, spherical shells, change in dimension of the shell due to internal pressure, change in volume of the shell due to internal pressure.
Thick Cylinders: Lame's equation- cylinders subjected to inside and outside pressures columns and Struts.

UNIT-IV:
Steam boilers and Reciprocating air compressors: Classification of boilers, essentialities of boilers, selection of different types of boilers, study of boilers, boiler mountings and accessories.
Reciprocating air compressors: uses of compressed air, work done in single stage and two-stage compression, inter cooling and simple problems.

UNIT-V:
Internal combustion engines: classification of IC engines, basic engine components and nomenclature, working principle of engines, Four strokes and two stroke petrol and diesel engines, comparison of CI and SI engines, comparison of four stroke and two stroke engines, simple problems such as indicated power, brake power, friction power, specific fuel consumption, brake thermal efficiency, indicated thermal efficiency and mechanical efficiency.

UNIT-VI:
Transmission systems:
Belts –Ropes and chain: belt and rope drives, velocity ratio, slip, length of belt , open belt and cross belt drives, ratio of friction tensions, centrifugal tension in a belt, power transmitted by belts and ropes, initial tensions in the belt, simple problems.
Gear trains: classification of gears, gear trains velocity ratio, simple, compound –reverted and epicyclic gear trains.

Outcomes:

After completing the course, the student shall be able to determine:

- The stress/strain of a mechanical component subjected to loading.
- The performance of components like Boiler, I.C.Engine, compressor, steam/hydraulic turbine, belt, rope and gear.
- The type of mechanical component suitable for the required power transmission.

Text Books:

1. Strength of Materials and Mechanics of Structures", B.C.Punmia, Standard Publications and distributions, 9 th edition, 1991
2. Thermal Engineering, Ballaney,P.L., Khanna Publishers, 2003
3. Elements of Mechanical Engineering, A.R.Asrani, S.M.Bhatt and P.K.Shah, B.S. Publs**.**
4. Elements of Mechanical Engineering, M.L.Mathur, F.S.Metha&R.P.Tiwari Jain Brothers Publs., 2009**.**

Reference Book:

1. Theory of Machines, S.S. Rattan, Tata McGraw Hil , 2004 & 2009.

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech.Petroleum Engineering – I Semester.

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Learning Objectives: This is a basic course designed to make the student

- learn the basic principles of electrical laws and analysis of networks.
- understand the principle of operation and construction details of DC machines.
- understand the principle of operation and construction details of transformer.
- understand the principle of operation and construction details of alternator and 3-Phase induction motor.
- study the operation of PN junction diode, half wave, full wave rectifiers and OP-AMPs.
- learn the operation of PNP and NPN transistors and various amplifiers.

UNIT - I
Electrical Circuits: Basic definitions, Types of network elements, Ohm's Law, Kirchhoff's Laws, inductive networks, capacitive networks, series, parallel circuits and star-delta and delta-star transformations.

UNIT - II
Dc Machines: Principle of operation of DC generator – emf equation - types – DC motor types – torque equation – applications – three point starter, swinburn'sTest, speed control methods.

UNIT - III
Transformers: Principle of operation of single phase transformers – emf equation – losses – efficiency and regulation

UNIT - IV
Ac Machines: Principle of operation of alternators – regulation by synchronous impedance method –principle of operation of 3-Phase induction motor – slip – torque characteristics - efficiency – applications.

UNIT V
Rectifiers & Linear Ics: PN junction diodes, diode applications(Half wave and bridge rectifiers). Characteristicsofoperation amplifiers (OP-AMP) - Application of OP-AMPs(inverting, non inverting,integrator and differentiator).

UNIT VI
TRANSISTORS: PNP and NPN junction transistor, transistor as an amplifier, single stage CE Amplifier, frequency response of CE amplifier, concepts of feedback amplifier.

Outcomes: At the end of the course, the student will be able to

- analyse the various electrical networks.
- understand the operation of DC generators,3-point starter and conduct the swinburn's Test.
- analyse the performance of transformer.
- explain the operation of 3-phase alternator and 3-phase induction motors.

- analyse the operation of half wave, full wave rectifiers and OP-AMPs.
- explain the single stage CE amplifier and concept of feedback amplifier.

Text Books:

1. Electronic Devices and Circuits, R.L. Boylestad and Louis Nashelsky, 9th Edition, PEI/PHI 2006.
2. Surinder Pal Bali, Electrical Technology: Vol – I Electrical Fundamentals &Vol – II Machines and Measurement, Pearson, 2013.
3. John Bird, Electrical Circuit Theory and Technology, 4th Edition, Elsevier, 2010.

Reference Books:

1. Naidu, M. and S. Kamakshaiah, Electrical Technology, Tata McGraw-Hill, 2006.
2. Rajendra Prasad, Fundamentals of Electrical Engineering, 2nd Edition, PHI Learning, 2009.
3. Nagasarkar, T. K. and M. S. Sukhya, Basic Electrical Engineering, 2nd Edition, Oxford Publications, 2009.
4. Mithal, G. K., Industrial Electronics, 9th Edition, Khanna Publishers, 2000.

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech. Petroleum Engineering-I Semester.

CHEMICAL PROCESS CALCULATIONS

Learning Objectives: The subject of chemical process calculations is intended to make the students understand mainly the calculations involved in material and energy balances of process units. The students will be trained to

- understand and correctly implement unit conversions in process calculations.
- understand and apply theoretical knowledge towards problem solving.
- analyze and solve elementary material balances in physical and chemical processes.
- analyze and solve elementary energy balances in reactive and non-reactive processes.
- formulate and solve combined material and energy balances.
- realize the relevance of thermodynamics in process calculations.
- carry out complex process calculations using MS Excel.

UNIT-I:
Stoichiometric relation: basis of calculations, methods of expressing compositions of mixtures and solutions, density and specific gravity, Baume and API gravity scales.

Behavior of Ideal gases: Kinetic theory of gases, application of ideal gas law, gaseous mixtures, gases in chemical reactions.

UNIT-II:
Vapor pressure: Liquefaction and liquid state, vaporization, boiling point, effect of temperature on vapor pressure, Antoine equation, vapor pressure plots, estimation of critical properties, vapor pressure of immiscible liquids and ideal solutions, Raoult's law, Non-volatile solutes.

UNIT-III:
Humidity and Saturation: Relative and percentage saturation or dew point, wet bulb and dry bulb temperature, use of humidity charts for engineering calculations.

UNIT-IV:
Material balances: Tie substance, Yield, conversion, processes involving chemical reactions.

Material balance calculation involving drying, dissolution and crystallization. Processes involving recycles, bypass and purge.

UNIT-V:
Thermophysics: Energy, energy balances, heat capacity of gases, liquid and mixture solutions. Kopp's rule, latent heats, heat of fusion and heat of vaporization, Trouton's rule, Kistyakowsky equation for non polar liquids enthalpy and its evaluation.

Thermochemistry: Calculation and applications of heat of reaction, combustion, formation and neutralization, Kirchoff's equation, enthalpy concentration change, calculation of theoretical and actual flame temperatures.

UNIT-VI:

Combustion Calculations: Introduction, fuels, calorific value of fuels, coal, liquid fuels, gaseous fuels, air requirement and flue gases, combustion calculations, incomplete combustion, material and energy balances, thermal efficiency calculations.

Out Comes: A student who successfully completes this course will be able to

- learn all background information/charts/datasheets required to carry out process calculations. Some of these are vapor pressure correlations, latent heat correlation, steam tables, psychrometric charts, enthalpy-concentration diagrams etc.,
- formulate and solve simple and moderately complex process calculations associated to industrially prominent chemical processes and technologies.
- conceptualize an integrated methodology that encompasses the knowledge in other subjects (Physical Chemistry, Thermodynamics and Mathematics) and MS Excel for a systematic and structured approach towards chemical process calculations.
- analyze chemical processes through the power of modeling and computation. These include back-calculation methods, inventory losses and revenue related assessment etc.

Text Book:

1. Hougen O A, Watson K.M. and Ragatz R.A., Chemical Process Principles, Part -I, Material and Energy Balances, 2nd Edition, CBS Publishers & distributors, New Delhi (2010).

Reference Books:

1. Himmelblau,D.H., Basic Principles and Calculations in Chemical Engineering, 7th Edition. PHI, 2009.
2. R. M. Felder and R. W. Roussear, Elementary principles of chemical processes, 3rd Ed., Wiley, 1999.
3. N. Chopey, Handbook Chemical Engineering Calculations, 3rd Edition, Mc-Graw Hill, 2004.
4. Bhatt, B. I., Thakore S. B., Stoichiometry, 5th Ed., Tata Mc-Graw Hill Education 2010.

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech Petroleum Engineering – I Semester.

BASIC ENGINEERING (Mech+Elec) LABORATORY

Any SIX experiments from each section

Section A: Mechanical Engineering Laboratory:

Learning Objectives:
To impart practical exposure on the performance evaluation methods of various mechanical components like, I.C.Engine, Hydraulic turbine, hydraulic pump, Air compressor etc. and also understand the various processes that can be performed on a lathe machine.

List of Experiments:

1. Draw the valve timing diagram of a 4-stroke diesel engine and port timing diagram of a 2-stroke petrol engine.
2. Perform load test on a 4-stroke C.I.Engine and draw the performance curves.
3. Pattern design and making – for one casting drawing.
4. Taper turning and thread cutting on a Lathe machine.
5. Performance on an Impulse/Reaction Hydraulic Turbine.
6. Performance of Centrifugal/Reciprocating Pump.
7. Find the volumetric efficiency, isothermal efficiency of an Air compressor.

Outcomes:
The student will be able to predict the performance of several mechanical components and operate a lathe machine to produce the required job work.

Section B: Electrical Engineering Laboratory:

Learning Objectives: This course course imparts knowledge to the students

- to learn the estimation of efficiency of a DC machine as motor & generator.
- to learn the estimation of efficiency of transformer at different load conditions & power factors.
- to study the performance of a 3-Phase induction motor by conducting direct test.
- to pre-determine the regulation of an alternator by Synchronous impedance method.
- to understand the speed control of a DC shunts motor.
- to study the performance of a DC shunts motor by conducting direct test.

The following experiments are required to be conducted as compulsory experiments:

1. Swinburne's test on D.C. Shunt machine. (Predetermination of efficiency of a given D.C. Shunt machine working as motor and generator).
2. OC and SC tests on single phase transformer (Predetermination of efficiency and regulation at given power factors)
3. Brake test on 3-phase Induction motor (Determination of performance characteristics)
4. Regulation of alternator by Synchronous impedance method.
5. Speed control of D.C. Shunt motor by
   a) Armature Voltage control b) Field flux control method

6. Brake test on D.C Shunt Motor

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

- estimate the efficiency of a DC machine as motor & generator.
- estimate the efficiency of transformer at different load conditions & power factors.
- understand the performance of a 3-Phase induction motor by conducting direct test.
- pre-determine the regulation of an alternator by Synchronous impedance method.
- control the speed of a DC shunt motor by Field flux control method & Armature Voltage control method.
- understand the performance characteristics of a DC shunt motor by conducting direct test.

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech Petroleum Engineering – I Semester.

GEOLOGY LAB & SURVEYING LAB

GEOLOGY LAB

Experiments	Objective	Outcome: Student can understand
1. Location of observed outcrops on the Top sheet. Geological mapping and Traversing.	To identify location of outcrops on the topo sheet, geological mapping.	Plotting geological mapping.
2. Measurement of the strike, dip and apparent and true thickness of the outcrops.	To measure strike and dip. To learn representation of strike and dip in different locations such as hills beach etc.	Plotting strike and dip in different geological locations such as hills, river banks, beaches etc.
3. Carrying out sampling of the outcrops for petrological, palynological and palentological studies.	To collect samples for petrological, palynological and palentlogical studies.	Collection of samples of outcrops for different studies and the importance of such studies.
4. Preparation of the geological map of the area, structure contour maps and isopach maps for different stratigraphic levels.	To train for drawing area geological map, structure contour and isopach maps.	How to use the maps to estimate reservoir area and thickness.
5. Preparation of litho stratigraphic columns, litho stratigraphic correlation, geological cross sections.	To find importance of litho stratigraphic columns, plotting geological cross sections.	Plotting litho strati-graphic column and geological cross sections.
6. Preparation of structural contour map and location of Oil Water Contact (OWC)	To determine the location of oil-water contact in the reservoir.	Confirmation of the height of the oil bearing sand.
7. Interpretation of isopach map and depositional model.	To train reading of isopach map and depositional model.	Reading of isopach map and depositional model.
Field trips to the different deltaic environments of Godavari delta	To make students to do geology survey in Godavari delt using above mentioned methods	Student can be in a position to plot geological map, strike, dip and litho stratigraphic column etc. at any chosen location.

SURVEYING LAB

Experiments	Objective	Outcome: Student can understand
1. Study of linear measuring instruments and chain surveying.	To teach linear measurement system and chain surveying.	Student can learn the meaning of linear measuring instrument. Chain surveying and measuring horizontal distances.
2. Study of theodolite and traversing with theodolite.	To teach measurement of angles.	Using theodolite, precision and its applications in various fields. Measuring angles in horizontal and vertical planes.
3. Study of levels and ordinary leveling with tilting level, Profile leveling.	To teach measurement of leveling.	Student can learn meaning of bench mark, fixing up bench mark, Importance of leveling, leveling in a horizontal plane. Measurement of vertical distances. Representation of vertical distances. Using tilting level, accuracy in measurement of angles, its advantages and disadvantages. Meaning of profile leveling and plotting a profile level diagram.
4. Study of total station and measurement with total station.	To teach measuring of distances and angles at a time.	Using total station, its advantages with conventional measuring instruments. Measuring angles and distances using total station and data processing after the measurements. Applications of total station in various fields such as mining, construction etc.
5. Study of Global Positioning System (GPS) and measurement with GPS.	To teach dynamic data acquisition.	Importance of GPS and its applications in various fields. Measurement of and any dynamic data with respect to time for example wave height.
6. Measurement and errors	To teach sources of errors and minimizing measure-ment errors.	Minimizing of measurement errors.

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2nd Year II – Semester Syllabus

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech. Petroleum Engineering – II Semester.

PROBABILITY AND STATISTICS

UNIT - I

Random variables and Distributions:

Introduction- Random variables- Distribution function- Discrete distributions (Review of Binomial and Poisson distributions)-

Continuous distributions: Normal, Normal approximation to Binomial distribution, Gamma and Weibull distributions

Subject Category
ABET Learning Objectives a b e k
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT - II

Moments and Generating functions:

Introduction-Mathematical expectation and properties - Moment generating function - Moments of standard distributions (Binomial, Poisson and Normal distributions) – Properties

Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT - III

Sampling Theory:

Introduction - Population and samples- Sampling distribution of mean for large and small samples (with known and unknown variance) - Proportion sums and differences of means - Sampling distribution of variance -Point and interval estimators for means and proportions

Subject Category
ABET Learning Objectives a e k
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT - IV

Tests of Hypothesis:

Introduction - Type I and Type II errors - Maximum error - One tail, two-tail tests- Tests concerning one mean and proportion, two means- Proportions and their differences using Z-test, Student's t-test - F-test and Chi -square test - ANOVA for one-way and two-way classified data

Subject Category
ABET Learning Objectives a b d e h k
ABET internal assessments 1 2 6 7 10
JNTUK External Evaluation A B D E F

UNIT - V

Curve fitting and Correlation:

Introduction - Fitting a straight line –Second degree curve-exponential curve-power curve by method of least squares.

Simple Correlation and Regression - Rank correlation - Multiple regression

Subject Category
ABET Learning Objectives a d e h k
ABET internal assessments 1 2 6 10
JNTUK External Evaluation A B E

UNIT - VI

Statistical Quality Control Methods:

Introduction - Methods for preparing control charts – Problems using x-bar, p, R charts and attribute charts

Subject Category
ABET Learning Objectives a e k
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E F

Text Books:

1. Richards A Johnson, Irvin Miller and Miller and Freund Johnson E Freund, Probability and Statics for Engineering, 8th Edition, PHI Learning, 2011
2. Sharon L. Myers, Keying Ye, Ronald E Walpole, Probability and statistics for Engineers and Scientists, 8th Edition, Pearson 2007
3. Willam Menden Hall, Robert J. Beaver and Barbara Beaver, Introduction to Probability and Statistics, Cengage Learning, 2009

Reference Books:

1. Sheldon, M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, 4th Edition, Academic Foundation, 2011
2. Ronald E. Walpole, Raymond Myers, Sharon L. Myers, Keying E. Ye, Essentials of Probability & Statistics for Engineers and Scientists, Pearson, 2013
3. Johannes Ledolter and Robert V. Hogg, Applied Statistics for Engineers and Physical Scientists, 3rd Edition, Pearson, 2010

Subject Category	ABET Learning Objectives	ABET Internal Assessments	JNTUK External Evaluation	Remarks
Theory Design Analysis Algorithms Drawing Others	w) Apply knowledge of math, science, & engineering x) Design & conduct experiments, analyze & interpret data y) Design a system/process to meet desired needs within economic, social, political, ethical, health/safety, manufacturability, & sustainability constraints z) Function on multidisciplinary teams aa) Identify, formulate, & solve engineering problems bb) Understand professional & ethical responsibilities cc) Communicate effectively dd) Understand impact of engineering solutions in global, economic, environmental, & societal context ee) Recognize need for & be able to engage in lifelong learning ff) Know contemporary issues gg) Use techniques, skills, modern tools for engineering practices	25. Objective tests 26. Essay questions tests 27. Peer tutoring based 28. Simulation based 29. Design oriented 30. Problem based 31. Experiential (project based) based 32. Lab work or field work based 33. Presentation based 34. Case Studies based 35. Role-play based 36. Portfolio based	O. Questions should have: P. Definitions, Principle of operation or philosophy of concept. Q. Mathematical treatment, derivations, analysis, synthesis, numerical problems with inference. R. Design oriented problems S. Trouble shooting type of questions T. Applications related questions U. Brain storming questions	

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech Petroleum Engineering – II Semester.

PETROLEUM GEOLOGY

Learning Objectives: This is a basic course in petroleum geology. The students will be exposed to different source, reservoir and cap-rocks, characterization of reservoir rocks, classification of reservoir porespace, permeability, migration and entrapment, temperature-pressure conditions for the generation of oil and gas from sediments.

UNIT-I:
Source Rocks: Definition of source rock. Organic rich sediments as source rocks. Nature and type of source rocks - Claystone / shale. The process of diagenesis, catagenesis and metagenesis in the formation of source rocks. Evaluation of petroleum source rock potential. Limestone as source rocks. Subsurface pressure temperature conditions for the generation of oil and gas from the source sediments. Oil window.

UNIT-II:
Reservoir Rocks: Characteristics of Reservoir rocks – classification and nomenclature: Clastic Reservoir Rocks, Carbonate Reservoir Rocks, Unconventional, fractured and miscellaneous reservoir rocks. Marine and non-marine reservoir rocks.

UNIT-III:
Reservoir Properties and Cap Rocks: Reservoir pore space - porosity – primary and secondary porosity, Effective porosity, fracture porosity - permeability – effective and relative permeability Relationship between porosity, permeability and texture. Cap rocks: Definition and characteristics of 'cap Rocks'.

UNIT-IV:
Hydrocarbon migration: Geological framework of migration and accumulation. The concept of hydrocarbon migration from source beds to the carrier beds - Carrier beds to the reservoir - Free-path ways for migration - Short distance and long distance migration - Evidence for migration – oil and gas seepages.

UNIT-V:
Entrapment of hydrocarbons
Entrapment and accumulation of hydrocarbons - Classification and types of traps: Structural, stratigraphic and combination type of traps - Traps associated with salt domes.

UNIT-VI:
Sedimentary Basins: Sedimentary basins -origin and classification. Types of basins and their relationship to hydrocarbon prospects.Tectonic classification, stratigraphic evolution and hydrocarbon accumulations of the following basins:Krishna-Godavari basin, Cambay basin and Mumbai off-shore

Outcomes: After successful completion of the course, the students are expected to

- identify different source rocks from which hydrocarbons are generated.

- discern about origin of source rocks, formation of good source rocks, different characterization of reservoir rocks, classification, nomenclature and different source of reservoir rocks, pore space, porosity and its types.
- gain knowledge of how and why fluid hydrocarbons migrate from a source rock to reservoir rock, entrapment and accumulation of hydrocarbons,
- do tectonic classification, strtigraphic evaluation and hydrocarbon accumulation of KG basin, Combay basin and Mumbai off-shore.

Text Book:

1. Levorsen, A.I. Geology of Petroleum, 2nd Edition., CBS, Publishers, 2006.

Reference Books:

1. Richard, C. Selley, Elements of Petroleum Geology, Elsevier, 1997.
2. Sedimentary basins of India- ONGC bulleting
3. CainengZou et al., Unconventional Petroleum Geology, Elsevier, 2013.

University College of Engineering Kakinada (A), JNTUK
II Year B.Tech. Petroleum Engineering- ISemester.

MATERIALS SCIENCE AND ENGINEERING

Learningobjectives:This subject is intended to make the student aware of

- choosing or selecting a suitable materials of construction of chemical/petrochemical process equipment, piping and internals.(each device/components has its own specific usage under different process environmental conditions):
- choosing judiciously the material so that it meets the specific life expectancy by reducing the shutdown frequency.
- minimizing the equipment breakdown and increasing the on-stream factor.
- selecting the material such that it withstands the severe process operating conditions such as cryogenic, high temperature, high pressure, acidic, basic, stress induced chemical/petrochemical environments keeping view the reliability and safety of the process equipment.

UNIT-I:
Classification of engineering materials, Levels of Structure, Structure-Property relationshipsin materials, Crystal Geometry and non-crystalline(amorphous) states. Lattice -Bravais lattices, crystal systems with examples. Lattice co-ordinates, Miller and Miller- BravaisIndices for directions and places: ionic, covalent and metallic solids; packing factors and packing efficiency,ligancy and coordination number.Structure determination by Brag's X-raydiffraction method.

UNIT-II:
Crystal Imperfections-classification-point defects-estimation of point defects-Dislocations-classification(edge and screw)-surface defects -dislocation motion and its relevance to mechanical and chemical properties –stress-strain relationship and diagrams for different materials(metals, non-metals, rubbers and plastics and polymers)-elastic and plastic deformation-slip -stress required to move a dislocation.Multiplication of dislocations –dislocation reactions, effect on mechanical behavior of materials.Strain hardening/work hardening –dynamic recovery and recrystallization.

UNIT-III:
Fracture and failure of materials: ductile fracture analysis-brittle fracture analysis-fracture toughness-ductile-brittle transition-fatigue fracture-theory, creep and mechanism –methods to postpone the failure and fracture of materials and increase the life of the engineering components /structures.

UNIT-IV:
Solid –liquid and solid-solid equilibriaformetals and alloys. Phase rule-phase diagram for pure metals (single component system),alloys(binary systems)-micro structural changes during cooling-Lever rule and its applications-typical phase diagrams-homogeneous and heterogeneous systems, formation of Eutectic, Eutectoid mixtures- non-equilibrium cooling.Binary Systems(phase diagrams) for study: Cu-Ni,Bi-Cd,Pb-Sn, Fe-C ,Al-Cu

UNIT-V:
Materials for chemical and petrochemical industrial process equipment- Effect of alloying on mechanical and chemical behavior of materials, applicationsof heat treatment methods for strengthening of engineering materials.

Composite structures and their advantages over conventional materials–Matrix-reinforcement properties and evaluation of strength properties with different orientation of reinforcement-applications –Nano materials –synthesis and characterization.

UNIT-VI
Stability criteria of materials in chemical/petrochemical industrial environments.Corrosion and Oxidation of materials –basic mechanisms-types of corrosion,Corrosion testing and evaluationPrevailing methods to combat corrosion. Coatings –metallic non-metallic, passivity, cathodic protection.

Out Comes:
After the course, the students will be

- equipped with knowledge to prepare material selection diagram, evaluation of equipment life and prediction of life of the equipment.
- acquiring the abilities to carryout reliability studies.
- ready to carryout equipment failure analysis and propose the remedial measures.

Text Books:

1. Raghavan, V., Materials Science and Engineering; 5th Edition, PHI, New Delhi, 2009.
2. Ravi Prakash, William F.Smith, and JavedHashemi, Material Science and Engineering, 4th Edition, Tata-McGraw Hill, 2008.

Reference Books:

1 Elements of Material Science and Engineering, Lawrence H. Van Vlack, 6th Edition, Pearson, 2002.
2 Balasubramaniam,R., Callister's Materials Science and Engineering, Wiley, 2010.
3 Mars G. Fontana, Corrosion Engineering, Tata-McGraw Hill, 2005.

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech. Petroleum Engineering- IISemester.

MOMENTUM TRANSFER

Learning Objectives: This course involves the fundamentals of fluid flow by including both theory and the applications of fluid flow in chemical engineering. Basic concepts of fluid mechanics will be taught to make the students to

- understand basic concepts associated to fluid flow such as viscosity, shear, newtonian and non-newtonian fluids etc.
- learn and apply continuity and Navier Stokes equation as a fundamental equation for the analysis of chemical processes.
- learn and apply the concept of boundary layer theory and governing mathematical equations for newtonian and non-newtonian fluid flow.
- learn and apply Bernoulli's equation for various simple and complex cases of fluid flow.
- understand the basic differences between compressible and incompressible fluid flow and suitably adapt, modify and apply suitable correlations for compressible fluid flow.
- have sound knowledge with respect to various important fluid flow related machinery and equipment. Emphasis shall be towards various types of pumps, compressors and blowers.
- master the relevant theory for the application of fluid flow past solid surfaces. Emphasis is towards drag and pressure drop correlations for packed and fluidized beds.
- understand various accessories required for fluid flow such as fittings and valves and their relevance towards variation in pressure drop correlations.
- understand the knowledge related to various fluid flow measuring devices (Venturi, Orifice, Rotameter and Pitot Tube).

UNIT-I:
Basic concepts of Dimensional analysis, nature of fluids, hydrostatic equilibrium, applications of fluid statics.

Fluid flow phenomena-Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, Boundary layers.

UNIT-II:
Basic equation of fluid flow –Mass balance in a flowing fluid; continuity, differential momentum balance; equations of motion, macroscopic momentum balances, Mechanical energy equations.

UNIT-III:
Incompressible Newtonian/Non-Newtonian flow in pipes and channels- shear stress and skin friction in pipes, laminar flow in pipes and channels, turbulent flow in pipes and channels, friction from changes in velocity or direction.

UNIT-IV:
Flow of compressible fluids- Definitions and basic equations, Processes of compressible flow, Isentropic flow through nozzles, adiabatic frictional flow, and isothermal frictional flow.

UNIT-V:
Flow past immersed bodies, Drag and Drag coefficient, flow through beds of solids, motion of particles through fluids.
Fluidization, Conditions for fluidization, Minimum fluidization velocity, Types of fluidization, Expansion of fluidized bed, Applications of fluidization, Continuous fluidization, slurry and pneumatic transport.

UNIT-VI:
Transportation and Metering of fluids- Pipes, fittings and valves, pumps: positive displacement pumps, and centrifugal pumps, fans, blowers, and compressors Measurement of flowing fluids-full bore meters, insertion meters.

Out Comes:
By mastering the fluid mechanics course, the student shall be able to:

- analyze fluid flow in circular and non-circular conduits.
- do calculations associated to the estimation of friction factor and pressure drop in circular conduits.
- do calculations involving Bernoulli's equation for the transport of acidic, alkaline, hydrocarbon and miscellaneous incompressible fluids in pipelines.
- calculate the pressure drops and energy requirements associated to compressible fluid flow in circular and rectangular ducts.
- estimate pressure drop in packed and fluidized beds.
- rigorously carry out various calculations associated to fluid flow in various types of pumps, fans and blowers.
- calculate, analyze and calibrate various flow measuring devices.

Text Books:

1. McCabe,W.L., J.C.Smith& Peter Harriot Unit Operations of Chemical Engineering, McGraw-Hill, 7th Edition, 2001.
2. Christie J. Geankoplis, Transport Processes and Unit Operations, PHI, 2003.

Reference Books:

1. Fox, R.W. and A.T.McDonald, Introduction to fluid mechanics, 5th edition, John wiley& sons, 1998.
2. J.M.Coulson and J.F.Richardson, Chemical engineering, Vol-1: Fluid flow, Heat Transfer and Mass Transfer, Pergamon Press, 4th Edition,1990.
3. Noel De Nevers, Fluid Mechanics for Chemical Engineers, Tata McGraw-Hill, 2011.
4. Bragg R and F. A. Holland, Fluid Flow for Chemical and Process Engineers, 2nd Edition, Hodder Stoughton Educational, 1995.
5. Patrick Abulencia, J and Louis Theodore, Fluid Flow for the Practicing Chemical Engineer, John wiley and Sons, 2009.

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech. Petroleum Engineering – II Semester.

PROCESS HEAT TRANSFER

Learning Objectives:
This course is designed to introduce a basic study of the phenomena of heat transfer to carry out thermal design/ heat transfer process design for heat exchange systems such as process heat exchangers, reboilers, air/utility coolers/condensers, furnaces, boilers, super-heaters, evaporators, driers, cooling towers etc. The principles involve the estimation of overall heat transfer coefficients, heat transfer surface area, pressure drop involved in single-phase and multi-phase flow regimes.
The students will be trained to acquire skills to carry out the detailed mechanical design of heat exchangers such as number tubes, selection of shell and tube material, estimate number of baffles and also provide necessary information regarding TEMA classification.

UNIT-I:
Introduction: Nature of heat flow, conduction, convection, natural and forced convection, and radiation.
Heat transfer by conduction in Solids: Fourier's law, thermal conductivity, steady state conduction in plane wall & composite walls, compound resistances in series, heat flow through a cylinder, conduction in spheres, thermal contact resistance, plane wall: variable conductivity.
Unsteady state heat conduction: Equation for one-dimensional conduction, Semi-infinite solid, finite solid.

UNIT-II:
Principles of heat flow in fluids: Typical heat exchange equipment, countercurrent and parallel current flows, energy balances, rate of heat transfer, overall heat transfer coefficient, electrical analogy, critical radius of insulation, logarithmic mean temperature difference, variable overall coefficient, multi-pass exchangers, individual heat transfer coefficients, resistance form of overall coefficient, fouling factors, classification of individual heat transfer coefficients, magnitudes of heat transfer coefficients, effective coefficients for unsteady-state heat transfer.

UNIT-III:
Heat Transfer to Fluids without Phase change: Regimes of heat transfer in fluids, thermal boundary layer, heat transfer by forced convection in laminar flow, heat transfer by forced convection in turbulent flow, the transfer of heat by turbulent eddies and analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes.

UNIT-IV:
Natural convection: Natural convection to air from vertical shapes and horizontal planes, effect of natural convection in laminar flow heat transfer.
Heat transfer to fluids with phase change: Heat transfer from condensing vapors, heat transfer to boiling liquids.

UNIT-V:

Radiation: Emission of radiation**,** absorption of radiation by opaque solids, radiation between surfaces, combined heat transfer by conduction, convection and radiation.

Evaporators: Types ofEvaporators, performance of tubular evaporators, vapor recompression.

UNIT-VI:

Heat Exchange Equipment: General design of heat exchange equipment, heat exchangers, condensers, boilers and calendrias, extended surface equipment, heat transfer in agitated vessels, scraped surface heat exchangers, heat transfer in packed beds, heat exchanger effectiveness (NTU method).

Out Comes: Upon successful completion of this course, the student will be able to:

- understand the basic laws of heat transfer.
- account for the consequence of heat transfer in thermal analyses of engineering systems.
- analyze problems involving steady state heat conduction in simple geometries.
- develop solutions for transient heat conduction in simple geometries.
- obtain numerical solutions for conduction and radiation heat transfer problems.
- understand the fundamentals of convective heat transfer process.
- evaluate heat transfer coefficients for natural convection.
- evaluate heat transfer coefficients for forced convection inside ducts.
- evaluate heat transfer coefficients for forced convection over exterior surfaces.
- analyze heat exchanger performance by using the method of log mean temperature difference.
- analyze heat exchanger performance by using the method of heat exchanger effectiveness.
- Calculate radiation heat transfer between black body surfaces as well as grey body surfaces

Text Books:

1. McCabe, W.L., J.C Smith and Peter Harriott, Unit Operations of Chemical Engineering7th Edition, McGraw-Hill, 2005.
2. Y.V.C.Rao, Heat Transfer, Universities Press (India) Pvt. Ltd., 2001.

Reference Books:

1. D.Q. Kern, Process Heat Transfer, Tata- McGraw-Hill, 1997.
2. Holman, J.P., Heat Transfer, 9th Edition, Tata McGraw-Hill, 2008.
3. Donald Pitts andL.E.Sisson, Schaum's Outline of Heat Transfer, 2nd Edition, McGraw-Hill, 1998.
4. Sukhatme, P., A Text Book on Heat Transfer, , 5th Edition, Universities Press (India) Pvt. Ltd., 2005.
5. Binay Dutta, K., Heat Transfer: Principles and Applications, PHI Learning, 2009.
6. Coulson, J.M.; Richardson, J.F.; Backhurst, J.R.; Harker, J.H., Chemical Engineering: Fluid Flow, Heat Transfer and Mass Transfer, Vol.1, 6th Edition, Reed Elsevier India, 2006.

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech Petroleum Engineering – II Semester.

THERMODYNAMICS FOR PETROLEUM ENGINEERS

Learning Objectives: This course is designed to make the students:

a) understandzeroth, first and second laws of thermodynamics.
b) discern various thermodynamic properties such as internal energy, specific volume, enthalpy, entropy, specific heat etc. from fundamental correlations.
c) learn the application of various thermodynamic laws for the analysis of chemical processes
d) understand the concept and models of residual and excess Gibbs energy and the associated calculations for VLE, VLLE, SVE and SLE.
e) learn the application of the laws of thermodynamics for hydrocarbon (both liquid and gas) characterization, handling, storage and transport.

UNIT-I:
Introduction: The scope of thermodynamics, defined quantities; temperature, volume, pressure, work, energy, heat, Joules Experiments, SI units.

The first law and other basic concepts: The first law of thermodynamics, thermodynamic state and state functions, enthalpy, the steady-state steady flow process, equilibrium, the reversible process, constant-V and constant- P processes, heat capacity.

UNIT-II:
Volumetric properties of pure fluids: The PVT behavior of pure substances, virial equations, the ideal gas, the applications of the virial equations, Cubic equations of state, generalized correlations for gases.

UNIT-III:
The second law of thermodynamics: Statements of the second law, heat engines, thermodynamic temperature scales, thermodynamic temperature and the ideal-gas scale, Entropy, Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics. Mollier diagram and steam tables.

UNIT-IV
Thermodynamic Properties of Fluids: Property relations for homogeneous phases, Residual properties, Generalized property correlations for gases.

Thermodynamics of flow processes; principles of conservation of mass and energy for flow systems, analysis of expansion processes; turbines, throttling; compression processes – compressors and pumps; calculation of ideal work and last work. Examples on hydrocarbons and natural gas.

UNIT-V:
Solution thermodynamics: Basic concepts of chemical potential, phase equilibria, partial properties, fugacity coefficient, residual and excess Gibbs free energy, correlations for the estimation of fugacity coefficient, residual and excess Gibbs energy in vapor liquid equilibria.

UNIT-VI:

Phase Equilibria: Gamma/Phi formulation of VLE, VLE from Virial equations of state, and cubic equations of state, Introduction to vapor- liquid–liquid equilibrium (VLLE), solid-liquid equilibrium (SLE), and solid vapor equilibrium (SVE), equilibrium adsorption of gases on solids.

Outcomes: After completion of the course, the students shall be able to

- become conversant with all the basic concepts of thermodynamics and gain working knowledge in open, closed, isothermal, isobaric and isoentropic processes.
- use thermodynamic tables and diagrams for the estimation of internal energy, specific volume, enthalpy and entropy.
- apply equations such as ideal gas law, Vander Waal's equation and other cubic equations of state for the characterization of chemical process parameters.
- determine efficiencies of turbines, pumps, compressors, blowers and nozzles.
- rigorously use residual and excess Gibbs free energy models for design of oil and natural gas processing systems.

Text Book:

1. Smith,J.M., H.C.Van Ness and M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 7th edition, McGraw Hill, 2005.

Reference Books:

1. Characterization and Properties of Petroleum Fractions, M. R. Riaze, ASTM, International, 2005.
2. Tarek Ahmed, Equation of State and PVT analysis, Gulf publishing company, 2007.
3. Koretsky, M.D., Engineering and Chemical Thermodynamics, John Wiley & Sons, 2004.
4. Richard Elliott,J. and Carl T.Lira, Introductory Chemical Engineering Thermodynamics, 2nd Edition, Prentice Hall, 2012.
5. Stanley Sandler, Chemical, Biochemical and Engineering Thermodynamics, 4th Edition, Wiley India Pvt Ltd, 2006.
6. Vidal,J., Thermodynamics: Applications in Chemical Engineering and the Petroleum Industry, Edition Technip, 2003.
7. Kyle, B.G., Chemical and Process Thermodynamics, 3rd Edition, PHI Learning, 2008.
8. Thomas E. Dauber, Chemical Engineering Thermodynamics, McGraw Hill, 1985.

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech Petroleum Engineering – II Semester.

MOMENTUM TRANSFER LAB

Learning Objectives:
Fundamentals of momentum transfer will be demonstrated in a series of laboratory exercises like determination of discharge coefficient of orifice, venturi, notches, friction factors in pipes, pressure drop in packed and fluidized beds, fluid viscosity, characteristics of centrifugal pump, characterization of fluid flow, verification of Bernoulli's theorem, measurement of point velocities. Hands-on experience and communication skills will be achieved.

List of Experiments:

1. Identification of laminar and turbulent flows; Major equipment - Reynolds apparatus
2. Measurement of point velocities; Major equipment - Pitot tube setup
3. Verification of Bernoulli's equation; Major equipment – Bernoulli's Apparatus
4. Calibration of Rotameter; Major equipment – Rotameter Assembly
5. Variation of Orifice coefficient with Reynolds Number; Major equipment - Orifice meter Assembly.
6. Determination of Venturi coefficient; Major equipment – Venturi meter Assembly
7. Friction losses in Fluid flow in pipes; Major equipment - Pipe Assembly with provision for Pressure measurement
8. Pressure drop in a packed bed for different fluid velocities; Major equipment - Packed bed with Pressure drop measurement
9. Pressure drop and void fraction in a fluidized bed; Major equipment - Fluidized bed with Pressure drop measurement
10. Studying the coefficient of contraction for a given open orifice; Major equipment - Open Orifice Assembly
11. Studying the coefficient of discharge in a V-notch; Major equipment - V-notch Assembly
12. Studying the Characteristics of a centrifugal pump; Major equipment - Centrifugal Pump
13. Viscosity determination using Stoke's law; Major equipment – Terminal Velocity determination column.

Outcomes: After completion of the course**,** students will be able to do the following:

- operate fluid flow equipment and instrumentation.
- collect and analyze data using momentum transfer principles and experimentation methods.
- prepare reports following accepted writing and graphical techniques.
- perform exercises in small teams.
- demonstrate principles discussed in momentum transfer lecture course.
- demonstrate appropriate work habits consistent with industry standards.

University College of Engineering Kakinada (A), JNTUK
II Year B. Tech Petroleum Engineering – II Semester.

PROCESS HEAT TRANSFER LAB

Learning Objectives: Fundamentals of process heat transfer will be demonstrated in a series of laboratory exercises like determination of thermal conductivities of composite wall and metal rod, natural convective and forced convective heat transfer coefficients, both film and overall coefficients, Stefen-Boltzman constant, emissivity of a metal plate etc. Students will achieve hands-on experience and acquire communication skills while conducting experiments in a team.

List of Experiments:

1. Determination of total thermal resistance and thermal conductivity of composite wall.
2. Determination of thermal conductivity of a metal rod.
3. Determination of natural convective heat transfer coefficient for a vertical tube.
4. Determination of critical heat flux point for pool boiling of water.
5. Determination of forced convective heat transfer coefficient for air flowing through a pipe
6. Determination of overall heat transfer coefficient in double pipe heat exchanger.
7. Study of the temperature distribution along the length of a pin-fin under natural and forced convection conditions
8. Estimation of un-steady state film heat transfer coefficient between the medium in which the body is cooled.
9. Determination of Stefan – Boltzmann constant.
10. Determination of emissivity of a given plate at various temperatures.

Out Comes: Upon successful completion of this lab course, the student will be able to:

- understand the basics of experimental techniques for heat transfer measurements.
- operate the heat transfer equipment like heat exchangers
- process experimental data and obtain correlations to predict heat transfer coefficients for design of heat transfer systems.
- conduct the experiments at R & D level in the industry
- understand the professional and ethical responsibilities in the field of heat transfer.
- produce a written laboratory report.

R – 13: Petroleum Engineering
3rd Year I – Semester Syllabus

University College of Engineering Kakinada (A), JNTUK
III Year B. Tech. Petroleum Engineering – I Semester

PETROLEUM EXPLORATION

Learning Objectives:
The syllabus for Petroleum exploration should be aimed at the student to have a broad knowledge of exploration history in India. The student should know what are the basic methods which are used in Petroleum exploration with special emphasis on gravity/magnetic and more importantly the students should understand in detail about the Seismic methods which are the back bone of the whole gamut of Oil exploration.
At the same time Sedimentology and biostratigraphy are also important to understand the sedimentary sequences holding hydrocarbons as the knowledge of these will help in the log interpretation also.

UNIT-I
Introduction: Overview of petroleum exploration in India, Introduction to Geophysical/Geological methods used in Petroleum Exploration.

UNIT-II
Sedimentlogical and biostratigraphic approaches in hydrocarbon exploration.

UNIT-III
Basic concepts of Gravity/magnetic methods: Newton's gravitational law- Units of gravity- Gravity measuring instruments- Gravity survey- Gravity anomalies- Gravity data reduction- Drift- latitude- Elevation and free air correction- Free air &bouguer anomalies- Gravity response of simple shapes- Interpretation of gravity anomalies- Application of gravity methods. The geomagnetic field- Magnetic anomalies- Magnetic survey-instruments- Field method of magnetic surveys- Reduction of magnetic data-Diurnal correction and geomagnetic correction- Interpretation of magnetic anomaly- Response of magnetic method for different type of bodies and geological structure- Application of magnetic surveys both overland and from air.

UNIT-IV
Basic Concepts of seismic methods: Seismic refraction surveys- Geometry of refracted path, planar interface- Two layer case with horizontal interface- Methodology of refraction profiling- Recording instruments & energy sources- Corrections applied to refraction data Interpretation of refraction data- Application of seismic refraction method.

UNIT-V
Geometry of reflected ray path: Single horizontal reflector- The reflection seismograph and seismogram (Seismic traces)- Importance of seismic reflection survey over seismic refraction survey technique- Common depth point (CDP) profiling & stacking- 2D, 3D, & 4D seismic surveys- Field procedures & principles- Time corrections applied to seismic data- Data processing- Interpretation of reflection data- Introduction to 3D data acquisition & interpretation.

UNIT-VI
Well seismic shooting for velocity determination and Vertical Seismic Profiling (VSP).

Outcomes:

The outcome this is to give insight for the student to have a broad based understanding of the seismic exploration, viz its acquisition methods, processing and interpretation, as they have already had geology in IIndyear course. The knowledge of these methods will go a long way along with the other paper i.e, logging methods for them to opt for upstream industry jobs if they so desire.

Text Books:

1. Introduction to Geophysical Prospecting, Milton B. Dobrin, and Carl H. Savit, 4thEdition, McGraw Hill, 1988.
2. Outlines of Geophysical Prospecting: A Manual for Geologists, M.B. Ramachandra Rao, EBD Educational Pvt Ltd., 1993.
3. Field Geophysics, John Milsom and AsgerEriksen, 4thEdition, John Wiley, 2011.

Reference Book:

1. Elements of Geology: Oil and Gas Exploration Techniques, J. Guillemot, Technip 1991.

University College of Engineering Kakinada (A), JNTUK
III Year B. Tech. Petroleum Engineering – I Semester

WELL LOGGING & FORMATION EVALUATION

Over view:
This subject mainly deals with utility of logging and direct methods to explore hydrocarbons in a well. Logging methods are mostly indirect in finding hydrocarbons, whereas the direct methods give the direct indications of hydrocarbon presence. In logging, the tools like S.P, G.R etc., are used mainly for the identification lithology of the formations. The electrical tools namely latero, induction etc., are used to record the resistivity of different formations encountered and also tools like Density, Neturon-neturon etc., are used for calculation of Porosity of subsurface formations. From the above derived data the saturation of hydrocarbons in a formation can be estimated and in turn be useful for reserves estimation. With the help of Cased hole logging tools like CBL, USIT, Production logging etc., the quality of cementation behind casing, the production problems in a well, repairing jobs related to production, perforation of casing, tubing etc., can be addressed.
With the advent of advanced technology tools like scanner, NMR, modular formation tester etc., the reservoir characters can be better defined. Thro' the quick look methods the qualitative interpretation of well logs can be done at the well site itself.

Learning objectives:

- To know the logging terminology
- To delineate hydrocarbons through direct and indirect means/methods
- Determination of formation lithology through logs like S.P, G.R etc. and also depositional environment with the help of Gamma rays spectroscopy and Dip-meter tools
- Determination of physical properties of the subsurface, strata like resistivity, porosity, thickness etc. through tools like latero, induction, density, neutron, etc.
- Hydrocarbon saturation estimation with the data acquired by the logging tools
- Hydrocarbons reserves estimation in a particular block.
- Refinement of the log interpretation data with the help of advanced technology tools namely, Scanner, NMR, Modular formation tester etc.

UNIT-I:
Direct Methods: Mud logging- coring – conventional and sidewall coring - Core analysis.
Concepts of well logging: What is well logging? - Logging terminology-Borehole environment-Borehole temperature and pressure-Log header and depth scale-Major components of well logging unit and logging setup- Classification of well logging methods-Log presentation- Log quality control.

UNIT-II:
Open hole logging: SP Logging- Origin of SP, uses of SP log-Calculation of salinity of formation water- Shaliness-Factors influence SP log.
Resistivity log: Single point resistance log (SPR)- Conventional resistivity logs- Response of potential and gradient logs over thin and thick conductive and resistive formations-Limitations of conventional resistivity tools. Focused resistivity log- Advantages of focused resistivity tools over conventional resistivity tools.
Micro resistivity log: Conventional and focused micro resistivity logs and their application.

Induction log: Principle of induction tool and the advantages. Criteria for selection of induction and lateral logging tool. Determination of true resistivity (Rt) of the formation-Resistivity index-Archie's equation.

UNIT III:

Gamma ray log: principle of radioactivity-Uses of gamma ray log- Determination of shaliness of formation-API counts- Calibration of Gamma ray tool-Statistical fluctuation- Time constant.
Natural Spectral Gamma ray log: Principle and application.
Caliper log: Principle and application of caliper tool.
Density log: Principle of density tool- Environmental corrections-Porosity determination-Tool calibration. Litho density log.
Neutron log: Principle and application of neutron tool. Porosity determination.
Sonic log: Principle and application of sonic log-Bore hole compensation-Determination of primary and secondary porosity, determination of mechanical properties of rock, elastic constants, fractures etc.

UNIT IV:

Cased hole logging: Gamma ray spectral log-Neutron decay time log-Determination of fluid saturation behind casing-Cement bond log- Casing collar log-Depth control- Perforation technique- Free point locater and Plug setting-Casing inspection logs.
Production logging: Solving production problems with the help of Fluid Density log-Temperature log and Flow meter logs.

UNIT V:

Advances in Well logging: Dip meter log-Formation tester-Cased hole resistivity logs -Nuclear magnetic resonance log & Scanner logs (Sonic scanner, MR scanner Rt scanner).
Outcome: Calculating the dip of the formations, collection of fluid samples from wells for confirmation of log interpretation, and also recording resistivity in cased holes.

UNIT VI:

Interpretation: Quick look interpretation- Cross plots. Neutron- Density, Sonic- Density, Sonic-Neutron cross plots-Hingle plot-Mid plot –Correlation- Hydrocarbon reserve estimate.

Outcomes:
From the well logs:

- Will be able to identify the lithology, depositional environment of subsurface strata.
- Will be able to calculate the porosity, permeability, thickness of different interesting layers in a well.
- Finally, the hydrocarbon saturation in different reservoir rocks can be calculated at the well site itself.

Text Books

1. Formation evaluation, Edward J. Lynch, Harper & Row, 1962.
2. Well logging and formation evaluation, Toby Darling, Elsevier, New York, 2005.
3. Well Logging & Reservoir Evaluation, Oberto Serra, Editions Technip, 2007.

Reference Books:

1. Hydrocarbon well logging recommended practice, Society of professional well log analysts.
2. Open – Hole log analysis and formation evaluation, Richard M. Batemons, International Human Resources Development Corporation, Bostan, 1985.
3. Well Logging for Earth Scientists, Darwin V. Ellis, Julian M. Singer, Springer, 2007.
4. Fundamentals of Well Log Interpretation: The Acquisition of Data, Oberto Serra, Elsevier, 1984.
5. Well Logging Handbook, Oberto Serra, Editions Technip, 2008.

University College of Engineering Kakinada (A), JNTUK
III Year B. Tech. Petroleum Engineering – I Semester

DRILLING TECHNOLOGY

Learning Objectives:

- To understand the plan of drilling a well, the process of drilling and various equipment used for drilling and design of the drill string.
- To know the drilling fluid importance and its properties and hydraulics.
- To understand different types of casings lowered in a well, the requirement of cementation in a well and cement slurry design.
- To understand different tools used for directional drilling and various techniques, fishing, stuck pipe and well control concepts.

UNIT-I
Overview of drilling: Drilling Planning Approaches- Drilling team- Types of drilling.

UNIT-II
Rotary bit technology- Drilling string basics.

UNIT-III
Drilling fluids and hydraulics: Drilling fluid economics- Drilling fluid properties- Drilling fluid report hydraulics calculations- Bit Hydraulics- Optimization- Swab & Surge-pressures- Mud hydraulics analysis report- Lost circulation.
Disposing of the drilling fluids waste and drill cuttings waste.

UNIT-IV
Casing & cementation: Fundamentals of casing design - Cementing: Introduction cement slurries-Typical field calculations- Cementing nomenclature- Cement additives –Cementation of lines - Casing & cementing analysis report.

UNIT-V
Directional drilling: Applications- Well planning- Down-hole motors- Deflection tools and techniques- Face orientation- Direction control with rotary assemblies- Navigation drilling systems- Fishing operations- Bi-centric bits.

UNIT-VI
Stuck pipe, well control: Kicks- Kick control- Pressure control theory- BOP-Special kick problems and procedures to free the pipes and Fishing operations.
Driller's logs: Sample logs- Miscellaneous logging devices.

Outcomes:
The students will be able to apply:

- The drilling concepts of a well from planning to rig mobilization to the location.
- The concept of a drill string design for drilling.
- The suitable drilling fluids during drilling.
- To do Casing and Cementation design.
- To carry out Directional drilling.

- To Trouble shoot well control, stuck pipe and fishing problems.

The students will be able to select the proper drilling equipment.

Text Books

1. Petroleum Engineering: Drilling and Well Completion, Carl Gatlin, Prentice-Hall, Inc., 1960.
2. Drilling Engineering, J.J. Azar and G.Robello Samuel, Pennwell Books, 2007.
3. Working Guide to Drilling Equipment and Operations, William Lyons, Gulf Publishing, 2009.

Reference Books:

1. Oil Well Drilling Engineering: Principles and Practice, H. Rabia, Graham & Trotman, 1985.
2. Drilling Engineering: A Complete Well Planning Approach, Neal Adams, Tommie CharrierPennwell, 1985.
3. Practical Well Planning and Drilling Manual, Steve Devereux, Pennwell, 1998.
4. Primer of Oil Well Service, Workover and Completion, Petroleum Extension Service, University of Texas at Austin, 1997.
5. Formulas and Calculation for Drilling, Production and workover, Norton J. Lapeyrouse, 2nd Edition, Gulf Publishing, 2002.
6. Applied Drilling Engineering, Adam T. Bourgoyne Jr., Keith K. Millheim, Martine E. Chenevert and F. S. Young Jr., Society of Petroleum Engineers, 1991.
7. Well Engineering and Construction, HussainRabia, Entrac Consulting, 2002.
8. Drilling Fluids Processing Handbook, ASME Shale Shaker Committee, Gulf Professional Publishing, 2005.
9. Fundamentals of Drilling Engineering, Robert F. Mitchell, Stefan Z. Miska, Society of Petroleum Engineers, 2011.

University College of Engineering Kakinada (A), JNTUK
III Year B. Tech. Petroleum Engineering – I Semester

WELL ENGINEERING

Learning Objective:

- To understand various aspects of engineering aspects of petroleum well.

UNIT-I

Pore pressure:

Hydrostatic pressure – Pore pressure – Causes of abnormal pore pressure – Thermodynamic processes – Abnormal pore pressure evaluation – Mud logging methods – Measurement while drilling & logging while drilling data – Direct measurements of pore pressure – Summary of pore pressure determination.

UNIT-II

Formation integrity tests – Fracture gradient determination – Theory of wellbore – FIT procedural Guidelines – Predicting fracture gradient – Casing seat selection method.

UNIT-III

Gas behavior in a well – Kick tolerance – Kick tolerance elements – When to calculate kick tolerance – How to calculate kick tolerance – Influence of FG on kick tolerance – Kick tolerance while drilling – Kick tolerance graph – Modifying the calculate kick tolerance – Use of kick tolerance to calculate wellbore pressures.

UNIT-IV

Functions of casing – Types of casing – Casing properties – Casing strength properties – Casing specifications – Casing connections – Factors influencing casing design – Design criteria – Collapse criterion – Burst criterion – Combination strings – Tension criterion – Service loads during drilling and production operations – Compression loads – Biaxial effects – Triaxial analysis – Triaxial load capacity diagram.

UNIT-V

Wellbore stability – Determination of the magnitude and direction of the in situ stress fied – Determination of rock properties – Rock failure – Failure criteria – Stress distribution around a wellbore – Procedure for determining safe mud weights to prevent hole collapse – Preventing borehole instability.

UNIT-VI

Horizontal wells – Well profile design considerations – Torque and drag – Horizontal borehole stability – Extended reach well design – Multilateral wells – HPHT well design.

Outcomes: The students will be able to design a petroleum well considering the following engineering concepts:

- Pore pressure
- Formation integrity tests
- Kick tolerance

- Casing design
- Bore-well stability criterion

Text Books:

1. Well Engineering and Construction, HussainRabia, Entrac Consulting, 2002.
2. Applied Drilling Engineering, Adam T. Bourgoyne Jr., Keith K. Millheim, Martine E. Chenevert and F. S. Young Jr., Society of Petroleum Engineers, 1991.
3. Oil Well Drilling Engineering: Principles and Practice, H. Rabia, Graham & Trotman, 1985.

Reference Book:

1. Petroleum Engineering: Drilling and Well Completion, Carl Gatlin, Prentice-Hall, Inc., 1960.
2. Drilling Engineering, J.J. Azar and G. Robello Samuel, Pennwell Books, 2007.
3. Working Guide to Drilling Equipment and Operations, William Lyons, Gulf Publishing, 2009.
4. Drilling Engineering: A Complete Well Planning Approach, Neal Adams, Tommie CharrierPennwell, 1985.
5. Practical Well Planning and Drilling Manual, Steve Devereux, Pennwell, 1998.
6. Primer of Oil Well Service, Workover and Completion, Petroleum Extension Service, University of Texas at Austin, 1997.
7. Formulas and Calculation for Drilling, Production and workover, Norton J. Lapeyrouse, 2nd Edition, Gulf Publishing, 2002.
8. Drilling Fluids Processing Handbook, ASME Shale Shaker Committee, Gulf Professional Publishing, 2005.
9. Fundamentals of Drilling Engineering, Robert F. Mitchell, Stefan Z. Miska, Society of Petroleum Engineers, 2011.

University College of Engineering Kakinada (A), JNTUK
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PROCESS INSTRUMENTATION

Learning Objectives:

- To learn the basic elements of an instrument and its static and dynamic characteristics
- To study the various types of industrial thermometers
- To learn the basic concepts of various types of composition analysis
- To learn the various types of instruments for measurement of pressure, vacuum, head, density, level and flow measurement
- To get an overview of various recording, indicating and signaling instruments, transmission of instrument readings, instrumentation diagrams, control center, process analysis and digital instrumentation.

UNIT-I:
Fundamentals: Elements of Instruments, static and dynamic characteristics-Basic concepts of response of first order type instruments.
Industrial Thermometers 1: Mercury in glass thermometer-Bimetallic thermometer-Pressure spring thermometer, Static accuracy and response of thermometry.

UNIT-II:
Industrial Thermometers 2: Thermo electricity-Industrial thermocouples-Thermo couple wires-Thermo couple wells and response of thermo couples; Thermal coefficient of resistance-Industrial resistance-Thermometer bulbs and circuits-Radiation receiving elements-Radiation photo electric and optical pyrometers.

UNIT-III:
Composition analysis: Spectroscopic analysis by absorption, emission, mass and color measurement spectrometers-Gas analysis by thermal conductivity, analysis of moisture.
Pressure, vacuum and head: Liquid column manometers-Measuring elements for gauge pressure and vacuum-indicating elements for pressure gauges-Measurement of absolute pressure-Measuring pressure in corrosive liquids-Static accuracy and response of pressure gauges.

UNIT-IV:
Density and specific gravity measurements- direct measurement of liquid level-Pressure measurement in open vessels-Level measurements in pressure vessels-Measurement of interface level-Density measurement and level of dry materials.

UNIT-V:
Flow Meters: Headflow meters-Area flow meters-Open channel meters-Viscosity meters-Quantity meters-Flow of dry materials-Viscosity measurements.

UNIT-VI:
Recording instruments-Indicating and signaling instruments-Transmission of instrument readings-Controls center-Instrumentation diagram-Process analysis-Digital instrumentation.

Outcomes: The students will be able to

- Understand the basic elements of an instrument and its characteristics
- Become familiar with various types of instruments for measurement of various process variables like temperature, pressure, vacuum, head, level, composition, flow and density
- Get a clear perspective of various recording, indicating, signaling instruments, transmission of instrument readings
- Get an understanding of instrumentation diagrams, control center, process analysis and digital instrumentation

Text Book:

1. Industrial Instrumentation, Donald P.Eckman, CBS, 2004.

Reference Books:

1. Principles of Industrial Instrumentation, Patranabis, 2nd Edition, Tata McGraw-Hill, 1996.
2. Process Control and Instrumentation Technology, Curtis D. Johnson, 3rd Edition, Prentice Hall, 1988.
3. Process Instrumentation Applications Manual, Bob Connell, 2nd Edition, McGraw-Hill, 1995.

University College of Engineering Kakinada (A), JNTUK
III Year B. Tech. Petroleum Engineering – I Semester

PROCESS DYNAMICS AND CONTROL

Learning objectives:

- To understand and be able to describe quantitatively the dynamic behavior of process systems.
- To learn the fundamental principles of control theory including different types of controllers and control strategies.
- To learn how to estimate the stability limits for a system, with or without control.
- To calculate and use the frequency response of a system.
- To describe quantitatively the behavior of simple control systems and to design control systems.
- To gain a brief exposure to advanced control strategies.
- To learn how to tune a control loop and to apply this knowledge in the industry/laboratory.
- To learn the different types of control valves and design of the control valve**.**

UNIT-I:
Introduction to process dynamics and control, Response of First Order Systems - Physical examples of first order systems
Response of first order systems in series, higher order systems: Second order and transportation lag.

UNIT-II:
Control systems Controllers and final control elements, Block diagram of a Petrochemical rector control system.

UNIT-III:
Closed loop transfer functions, Transient response of simple control systems.

UNIT-IV:
Stability Criterion, Routh Test, Root locus, Transient response from root locus, Application of root locus to control systems Introduction to frequency response, Control systems design by frequency response.

UNIT-V:
Advanced control strategies, Cascade control, Feed forward control, ratio control, Smith predictor, dead time compensation, internal model control.

UNIT -VI:
Controller tuning and process identification. Control valves.

Outcomes:
At the completion of the course a student should be able to:

- Describe a process, how it works and what the control objectives are.

- Describe processes with appropriate block diagrams.
- Numerically model a process.
- Identify the stability limits of a system.
- Apply the advance control strategies.
- Tune process controllers.
- Experimentally determine the dynamic behavior of a process.
- Design and operate control valves.

Text Book:

1. Process Systems Analysis and Control by D.R. Coughanowr, 2nd ed. McGraw Hill, 1991

Reference Books:

1. Chemical Process Control, G. Stephanopolous, Prentice Hall, 1984
2. Coulson and Richardson's Chemical Engineering, Volume 3, 3rd Edition: Chemical and Biochemical Reactors and Process Control, Richardson J. F. et.al, Elsevier India, 2006.
3. Automatic Process Control, Donald P. Eckman, John wiley, Reprint 2011.
4. Process Dynamics and Control, Dale Seaborg, Thomas F. Edgar, Duncan Mellichamp, 2nd edition, Wiley India Pvt. Ltd., 2006.
5. Principles of Process Control. Patranabis, 3rd Edition McGraw-Hill Education Pvt. Ltd., 2012.
6. Industrial Process Control Systems, 2nd Edition, Dale R. Patrick, Stephon, W. Fardo, CRC Press, 2009.
7. Modern Control Systems, 11th Edition Dorf, Pearson, 2008.
8. Modern Control Engineering, Katsuhiko Ogata, 5th Edition, Prentice Hall, 2010.
9. Principles and Practices of Automatic Process Control, Carlos A. Smith, Armando B. Corripio, 3rd International Edition, John Wiley and Sons, 2005.
10. Process control: Concepts, Dynamics & Control, S. K. Single, PHI Learning, 2009.
11. Process control, Peter Harriott, Tata McGraw-Hill 1964. (10th reprint 2008).
12. Computer-Aided Process Control, S. K. Singh, PHE Learning, 2004.
13. Essentials of process control, William L. Luyben, Michacl L. Luyben, McGraw-Hill, 1997.

University College of Engineering Kakinada (A), JNTUK
III Year B. Tech. Petroleum Engineering – I Semester

INSTRUMENTATION & PROCESS CONTROL LAB

Learning Objectives:

- To calibrate and determine the time lag of various first and second order instruments.
- To determine the response in single and two capacity systems with and with-out interaction.
- To understand the advanced control methods used for complex processes in the industries. Different experiments like Flow, level and cascade control can be configured and studied.
- To study the open loop (Manual control) and the on/off controller, Proportional controller, PI controller, PD controller, PID controller, Tuning of controller (Open loop and close loop methods), and to study the stability of the system (Bode plot).
- To understand the control valve operation and its flow characteristics.
- To determine the damping coefficient and response of U-tube manometer.

Experiments:

1. Calibration and determination of time lag of various first and second order instruments.
   Major equipment - First order instrument like Mercury-in-Glass thermometer and overall second order instrument like Mercury-in-Glass thermometer in a thermal well.
2. Experiments with single and two capacity systems with and without interaction.
   Major equipment- Single tank system, Two-tank systems (Interacting and Non-Interacting).
3. Level control trainer
   Major equipment - Level control trainer set up with computer.
4. Temperature control trainer
   Major equipment -Temperature control trainer with computer.
5. Cascade control
   Major equipment -Cascade control apparatus with computer.
6. Experiments on proportional, reset, rate mode of control etc.
   Major equipment – PID control apparatus
7. Control valve characteristics
   Major equipment – Control valve set up.
8. Estimation of damping coefficient for U-tube manometer
   Major equipment - U-tube manometer.

Outcomes:

The student will be able to

- Estimate the dynamic characteristics of first and second order systems.
- Apply the advanced control methods used for complex processes in the industries.
- Screen and suggest controllers like On/off, P, PI, PD and PID for process systems.
- Identify the stability of the system.
- Screen and suggest the types of control valves.

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DRILLING FLUIDS LAB

Learning Objectives:

- The students will be provided hands on training in the determination of the properties of different drilling fluids.

Experiments:

1. Determination drilling fluid weight.
   Equipment: The baroid mud balance
2. Determination of mud viscosity.
   Equipment: Marsh funnel
3. Determination of pH of mud.
   Equipment: pH meter and hydrion pH dispensers
4. Determination of mud rheology (Viscosity, Gel strength, and Yield point).
   Equipment: The baroidrheometer
5. Determination of the loss of liquid from a mud.
   Equipment: Standard API filter press
6. Determination of a drilling mud cake and evaluate resistivity.
   Equipment: Baroid digital resistivity meter
7. Determination of the effect of adding bentonite on mud properties.
8. Drilling fluid contamination test (Salt, Gypsum & Cement contamination).
9. Determination of solid and liquid content and emulsion characteristics of drilling fluid.
   Equipment: Sand content set, fann emulsion and electrical stability testers
10. Oil, water, solid and clay content determination.
    Equipment: Oil/ water retort kit
11. Determination of water ratios for portland cement slurry.
    (Effect of water ratio on free water separation normal and minimum water content and thickening time)
    Equipment: The atmospheric consistometer
12. Determination of compressive strength of cement test moulds.
    Equipment: Compressive strength testing machine

Outcomes:

- The students will be able to understand and assess quality of various muds and their applications in drilling. With this knowledge, well control issues will be better understood.
- The training in the laboratory provides the students to carry out good conversation jobs for healthy construction of open oil / gas wells.

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INDUSTRIAL VISITS

Learning Objectives: To make the students aware ofindustrial environment, culture, requirements, nature of jobs and to develop accordingly.

During the semester, all the students are required to visit minimum 6 major industries like petroleum refineries, petrochemical, fertilizer and organic chemical complexes accompanied by two faculty members. After each visit, every student should submit a very brief report on the industry with flow diagrams and salient features of the processes that include safety and environmental aspects.

Outcomes: The students will be able to

- Differentiate between the academic training and its relevance to industry.
- Understand the industrial safety measures.

R – 13: Petroleum Engineering
3rd Year II – Semester Syllabus

University College of Engineering Kakinada (A), JNTUK
III Year B. Tech. Petroleum Engineering– II Semester

WELL COMPLETIONS

Learning Objectives:

1. Knowledge of subsurface equipment below well head.
2. Planning and designing of well completion after testing of the hydrocarbon zones available.
3. Knowledge of subsurface circulating equipment and packers.
4. Testing of multi zones in a well with DST/RFT with logging tools as well as surface testing equipment.

UNIT-I
Well completion: Types of wells- Completion functions- Types of completion.

UNIT-II
Mechanical aspects of well testing- Cased hole logging equipment and application and perforation methods and perforation equipment.
Packers: Function- Application- Proper selection- water / gas shut off, horizon separation etc.

UNIT-IV
Completion equipment (SSD, SSSV, mandrels, locks etc.)- Data acquisition in wells- Fibre optics- Permanent gauges- Memory gauges- SCADA systems- Intelligent completion equipment.

UNIT-V
Tubing string design (dimension, materials and connections etc.) based on pressure, temperature, operating conditions- Media- Safety requirements.
Drill Stem Testing: General Procedure and considerations- Test tool components and arrangement-Analysis of Test data.

UNIT-VI
HPHT and horizontal well completions- Workover equipment wireline- Scrubbing unit- Coil tubing completion and work over design and execution.
Introduction to well servicing and stimulation system – Objectives and applications.

Outcomes:

1. The student can have the knowledge of various equipments used in & on wells.
2. The student can have the knowledge of DST/RFT to know the initial potential of the wells.
3. He can plan and design the well completion depending of the casing policy and the number of objectives available in the well.
4. He can also plan for suitable safety valves in sub surface as well as on well head for the safe operation of the high pressure and high temperature wells.
5. He can also be a good work over engineer to repair and maintenance of a sick well.
6. He can be a good CTU (Coil Tubing unit) operator whenever a rig less operations are required to be taken up.

Text Books:

1. Well Completion and Servicing, D. Perrin, Micheal Caron, Georges Gaillot, Editions Technip, 1999.
2. Primer of Well Service, Workover and Completion, Petroleum Extension Service (PETEX), University of Texas at Austin, 1997.
3. Well Testing, John Lee, Society of Petroleum Engineers, 1982.

Reference Books:

1. Well Completion Design, Jonathan Bellarby, Elsevier, 2009.
2. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham & Trotman, Inc., 1986.
3. Advanced Well Completion Engineering, Wan Renpu, Gulf Professional Publishing, 2011.

University College of Engineering Kakinada (A), JNTUK
III Year B. Tech. Petroleum Engineering– II Semester

PETROLEUM RESERVOIR ENGINEERING-I

Learning Objectives:

i. The students will be imparted knowledge in the basic concept like PVT analysis for oil, Material balance applied to oil reservoir, Darcy's law and applications, well inflow estimation for stabilized flow conditions.
ii. To make them suitable as reservoir engineers for Petroleum industry

UNIT-I

Some basic concepts in reservoir engineering: Calculation of hydrocarbon volumes- Fluid pressure regimes- Oil recovery and recovery factor-Volumetric gas reservoir engineering – Application of the real gas equation of state - Gas material balance and recovery factor-Hydrocarbon phase behavior.

UNIT-II

PVT analysis for oil: Definition of the basic PVT parameters – Collection of fluid samples - Determination of the basic parameters in the laboratory and conversion for field operating conditions - Alternative manner of expressing PVT lab analysis results - Complete PVT analysis.

UNIT-III

Material balance applied to oil reservoirs: General form -The material balance expressed as a linear equation- Reservoir drive mechanism- Solution gas drive- Gas cap drive- Natural water drive- compaction drive under related pore compressibility phenomena.

UNIT-IV

Darcy's law and applications: Darcy's law and field potential- Sign convention- Units and units conversion- Real gas potential – Datum pressures- Radial steady state flow and well stimulation- Two phase flow- Effective and relative permeabilities.

UNIT-V

The basic differential equation for radial flow in a porous medium- Derivation of the basic radial differential equation – Conditions of solution – The linearization of the equation for fluids of small and constant compressibility.

UNIT-VI

Well inflow estimation for stabilized flow conditions: Semi steady state solution – Steady state solution – Example of the application of the stabilized inflow equations – Generalized form of inflow equation under semi steady state conditions.

Outcomes:

The students will be able to:

i. Docalculations on basic PVT analysis of the specific reservoir of various sands.
ii. Estimate the reserves of various sands of the reservoir from well data.
iii. Calculate the formation damage and can recommend suitable stimulation operations to reverse the wells.

Text Books:

1. Fundamentals of Reservoir Engineering, L.P. Dake, Elsevier Science, 1978 (17th Impression 1998).
2. B. C. Craft – M. Hawkins Applied Petroleum Reservoir Engineering, Third Edition, Revised by Ronald E. Terry & J. Brandon Rogers, Prentice Hall, New York, 2014.

Reference Books:

1. Reservoir Engineering Handbook, Tarek Ahmed, 3rd Edition, Gulf Professional Publishing, 2006.
2. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham &Trotman Inc. 1986.
3. Basic Reservoir Engineering, Rene Cosse, Editions Technip, 1993.
4. Petroleum Reservoir Engineering, James W Amyx, Daniel M. Bass Jr., Robert L. Whiting, McGraw Hill, 1960.

University College of Engineering Kakinada (A), JNTUK
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PETROLEUM PRODUCTION ENGINEERING& DESIGN

Learning Objectives:

- Understanding of reservoir fluids and characteristics.
- Flowing oil and gas from wells to the maximum extent without effecting the reservoir health.
- Suitable selection of artificial methods where self-flow of wells ceases.
- Diagnosing the sickness of the well/reservoir and according to carry suitable stimulation job to revive the wells back into production.

UNIT-I
Petroleum production system - Properties of oil & natural gas.

UNIT-II
Reservoir deliverability -Well bore performance.

UNIT-III
Choke performance - Well deliverability-Forecast of well production

UNIT-IV
Production decline analysis.
Transportation system: Design and Selection

UNIT-V
Artificial lift methods: Basics and Design of Sucker rod pumping - Gas lift - Other artificial lift methods.

UNIT-VI
Production Stimulation: Well problem identification - Matrix acidizing- Hydraulic fracturing-

Outcomes:

- The student can be good production engineer with sufficient reservoir knowledge.
- He can manage maximum oil/gas production without effecting the health of the reservoir.
- He can identify the actual problems of the sick well and apply suitable stimulation job to revive the well back to production.
- He can be a very good member in a multidiscipline teams for reduction of sick wells as well as improvement of oil/gas production.

Text Books:

1. Petroleum Production Engineering: A computer Assisted Approach, BoyunGuo, William C. Lyons, Ali Ghalambor, Elsevier Science & Technology Books, 2007.
2. Petroleum Production Systems, M. J. Economides, A. Daniel Hill & C. E. Economides, Prentice- Hall, N. J – 07488, 1994.

Reference Books:

1. Production Technology I-II, Institute of Petroleum Engineering, Herriot Watt University.
2. The Technology of Artificial Lift Method, Brown, K.E., Volume 1, PennWell Books, 1977.

University College of Engineering Kakinada (A), JNTUK
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PETROLEUM REFINERY AND PETROCHEMICAL ENGINEERING

Learning Objectives:

1. To understand the properties and their significance of crude oils and Petroleum fractions.
2. To understand, design and analyze the various petroleum refinery processes including primary, secondary and supporting processes.
3. To understand the process technologies for the petrochemical products.

UNIT-I

Introduction: Overall refinery operations & Indian scenario.

Refinery feed stocks: Crude oil classification-Composition and properties-Composition of petroleum crude suitable for asphalt/coke manufacture – Evaluation of crude oils.

UNIT-II

Petroleum Products and their specifications: LPG- Gasoline- Diesel fuels- Jet and turbine fuels –Lube oils-Heating oils – Residual fuel oils - wax and asphalt- Petroleum coke- All Product specifications-Product blending.

UNIT-III

Crude distillation: Atmospheric and Vacuum distillation units, Auxiliary equipment such as desalters, pipestill heaters and heat exchanger trains etc.

Catalytic reforming and isomerization: Catalytic reforming processes (for petroleum and petrochemical feed stocks) – Isomerization Processes -Feed stocks-Feed preparation – Yields.

UNIT-IV

Thermal & Catalytic cracking processes: Visbreaking- Delayed Coking –Fluid Catalytic cracking and Hydrocracking - Feed stocks — Catalysts - Process variables –Product Recoveries-Yield estimation

Hydrotreating&Hydroprocessing: Naphtha, Kerosene, Diesel, VGO &Resid, Hydrotreating / Hydroprocessing – Feed stocks – Process description and Process variables

UNIT-V

Petrochemical Industry – Feed stocks – Process description and Process variables-Naphtha cracking-Gas cracking and Gas reforming.

UNIT-VI

Chemicals from gas reforming: Methanol- Acetic acid- Ammonia and urea.

Chemicals from ethylene: Ethylene oxide-Monoethylene glycol-Ethyl benzene-Styrene

Polymers: LDPE, HDPE & LLDPE and Polypropylene – PVC - Polystyrene.

Learning Outcomes:

1. For a given crude assay, how to handle and store the crude oil.
2. What will be the yield, quality of the product, estimation for the primary processes and treatment considerations.
3. Maximize the profitable products and minimize the quality giveaway.

4. Ability to process the opportunity crudes (e.g. Blending with other crudes) to maximize the throughput and gross margin.
5. Application of suitable Hydroprocessing/treatment technologies to meet product qualities and to minimize the CAPEX & OPEX (capital and operating expenditure).
6. Application of suitable thermal/catalytic conversion (cracking) processes for Vacuum gas oil/residupgradation and to produce desired fuel blend components and petrochemical feed stocks.
7. Application of suitable processes (such as alkylation, reforming, isomerization) for converting light ends/ naphtha cuts to meet the desired gasoline blends.
8. Understanding of various petrochemical feed stocks and their origin from refining/gas processes.
9. Knowledge of various petrochemical products in the market and best available technologies to produce them.

Text Books:

1. Petroleum Refining: Technology and Economics, J.H. Gary and G.E.Handwerk, 4th Edition, Marcel Dekkar, Inc., 2001.
2. Elements of Petroleum Processing, D S Jones, Wiley 1995.
3. Petrochemical Process Technology, ID Mall, Macmillan India Ltd., 2007.

Reference Books:

1. Petroleum Refining Engineering, WL Nelson, 4th Edition, McGraw Hill Company, 1958.
2. Chemical Technology of Petroleum, W.S.Gruese and D.R. Stevens, McGraw Hill, 1960.
3. Fundamentals of Petroleum Chemical Technology, P Belov, Mir Publishers, 1970.
4. Petrochemical Processes, A. Chauvel and G.Lefebvre, Volume 1 & 2, Gulf Publishing Company, 1989.
5. Chemistry of Petrochemical Processes, Sami Mater, Lewis F. Hatch, 2nd Edition, Gulf Professional Publishing, 2001.
6. Chemicals from Petroleum: An Introductory Survey, Waddams, A.L., 4th Edition, Gulf Publishing, 1978.
7. Handbook of Petrochemicals Production Processes, R.A. Meyers, TRW,Inc., 2005.
8. Petrochemicals, P.Wiseman, Ellis Horwood, 1986.
9. Petrochemical Processes Handbook, Hydrocarbon Processing, 2010.
10. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, 5th Edition, Oxford & IBH Publishing, 2011.

University College of Engineering Kakinada (A), JNTUK
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SURFACE PRODUCTION OPERATIONS

Learning objectives:

- Operate and maintain the surface equipment installed in GGS/GCS.
- Smooth operation of equipment with minimum manpower and handling more crude oil/gas.
- Priority to safety operations so that free of even minor accidents.
- Have the knowledge of various Acts of safety and environmental protection.

UNIT-I

The production facility: Various types of facilities

Process selection: Controlling the process-Operation of a control valve: Pressure control- Level control- Temperature control- Flow Control- Basic system configuration: Wellhead and manifold- Separation- initial separation pressure- Stage Separation, Selection of Stages, Process flow sheet- Oil treating and storage- Lease automatic custody transfer- Water treating – Compressors- Gas dehydration- Well testing- Gas lift- Offshore platform considerations.

UNIT-II

Two phase oil and gas separation: Functional sections of a gas-liquid separator- Inlet diverter section- Liquid collection section- Gravity settling section- Mist extractor section- Equipment description of different separators- Scrubbers- Slug catchers- Selection considerations- Vessel internals- Mist extractors- Potential operating problems-Design of Two Phase Separators.

UNIT-III

Three phase oil and water separation: Equipment description- Horizontal separators- Derivation of equation- Free-water knockout- Flow splitter- Horizontal three-phase separator with a liquid "Boot"-Vertical separator- Selection considerations- Vessel internals- Coalescing plates- Turbulent flow coalescers and potential operating problems-Design of Three phase Separators.

UNIT-IV

Crude oil treating: Equipment description of various treaters and heaters- Indirect and fired heaters- Waste heat recovery- Heater sizing- Vertical heater-treaters- Coalescing media- Horizontal heater treaters- Electrostatic heater-treaters- Oil dehydrators- Emulsion treating theory- Age of the emulsion- Agitation- Emulsifying agents- Demulsifiers- Field optimization- Changing the demulsifier- Demulsifier troubleshooting- Emulsion treating methods- General considerations- Chemical addition- Amount of chemical- Bottle test considerations- Chemical selection-Design of crude oil treaters.

UNIT-V

Oil desalting systems: Oil desalting systems-Equipment description of desalters- Mixing equipment- Globe valves- Spray nozzles- Static mixers- Process description- Single stage desalting- Two stage desalting.

UNIT-VI

Produced water treating systems: Disposal standards- offshore & onshore operations- Characteristics of produced water- Scale removal- Controlling scale using chemical inhibitors- Sand and other suspended solids- Dissolved gases- Oil in water emulsions- Dissolved oil concentrations- Dispersed oil- Toxicants- Gravity separation- Coalescence- Dispersion- Flotation- Filtration- Equipment description-Skim tanks and vessels- Types of configurations- Pressure vs atmospheric vessels- Retention time and performance considerations-Design of Produced Water Treating Systems.

Outcomes:

- The student can learn the efficient separation of oil and gas.
- He can maintain the quality of oil, required by the refineries.
- The student can understand the various control systems fitted on the separators/heater-treaters, so that smooth operation of GGS/GCS can be maintained.
- He can understand the crude oil emulsions produced from various wells and he can treat such crudes to the required oil quality.
- He can understand various safety systems fitted from well to the surface equipment and he can ensure accident free operation till the oil is supplied to refiners and gas to consumers.
- He can also very well understand the treatment of produced water and disposal of the same as per the norms laid by SPCB.

Text Books:

1. Surface Production Operations, Ken Arnold & Maurice Stewart, Vol. 1 & 2 3rd edition, Gulf Professional Publishing, 2008.
2. Petroleum and Gas Field Processing, H.K.Abdel-Aal and Mohamed Aggour and M.A. Fahim, Marcel Dekkar Inc., 2003.

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INTELLECTUAL PROPERTY RIGHTS (IPR) & PATENTS

Unit I

Introduction to Intellectual Property Law – Evolutionary past – Intellectual Property Law Basics - Types of Intellectual Property - Innovations and Inventions of Trade related Intellectual Property Rights – Agencies Responsible for Intellectual Property Registration – Infringement - Regulatory – Over use or Misuse of Intellectual Property Rights - Compliance and Liability Issues.

Unit II

Introduction to Copyrights – Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law –Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of performers **–** Copyright Formalities and Registration – Limitations – Infringement of Copyright – International Copyright Law- Semiconductor Chip Protection Act.

Unit III

Introduction to Patent Law – Rights and Limitations – Rights under Patent Law – Patent Requirements – Ownership and Transfer – Patent Application Process and Granting of Patent – Patent Infringement and Litigation – International Patent Law – Double Patenting – Patent Searching – Patent Cooperation Treaty – New developments in Patent Law- Invention Developers and Promoters.

Unit IV

Introduction to Trade Mark – Trade Mark Registration Process – Post registration procedures – Trade Mark maintenance – Transfer of rights – Inter parties Proceedings – Infringement – Dilution of Ownership of Trade Mark – Likelihood of confusion – Trade Mark claims – Trade Marks Litigation – International Trade Mark Law

Unit V

Introduction to Trade Secrets – Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreement – Trade Secret Law – Unfair Competition – Trade Secret Litigation – Breach of Contract – Applying State Law.

Unit VI

Introduction to Cyber Law – Information Technology Act - Cyber Crime and E-commerce – Data Security – Confidentiality – Privacy - International aspects of Computer and Online Crime.

REFERENCE BOOKS:

1. Deborah E.Bouchoux: “Intellectual Property”. Cengage learning, New Delhi
2. Kompal Bansal &Parishit Bansal "Fundamentals of IPR for Engineers", BS Publications Press)
3. Cyber Law. Texts & Cases, South-Western’s Special Topics Collections
4. PrabhuddhaGanguli: ‘Intellectual Property Rights” Tata Mc-Graw – Hill, New Delhi
5. Richard Stim: "Intellectual Property", Cengage Learning, New Delhi.
6. R. Radha Krishnan, S. Balasubramanian: "Intellectual Property Rights", Excel Books. New Delhi.
7. M.Ashok Kumar and Mohd.Iqbal Ali: “Intellectual Property Right” Serials Pub.

University College of Engineering Kakinada (A), JNTUK
III Year B. Tech. Petroleum Engineering– II Semester

PETROLEUM ANALYSIS LAB

Learning Objectives:

The objective of the petroleum analysis lab is to determine the physical and transport properties like Reid vapor pressure, Viscosity, Smoke point, Flash point & Fire point, Aniline point, Cloud & Pour point, Softening point, Calorific value, Water content of different petroleum products by conducting laboratory experiments using different apparatus and to determine the distillation characteristics of petroleum products.

Experiments:

1. Determination of Distillation characteristics of Crude Oil, Gasoline, Diesel and Kerosene.
2. Determination of Reid Vapor Pressure of Crude oil & Gasoline.
3. Determination of Viscosity of Diesel and transformer oils.
4. Determination of Smoke Point of Kerosene.
5. Determination of Carbon Residue of petroleum oils.
6. Determination of Flash & Fire points of gasoline, kerosene and other products.
7. Estimation of water content in petroleum products.
8. Estimation of calorific value of solid, liquid and gaseous fuels.
9. Determination of Aniline point of Gasoline and Diesel oil.
10. Determination of softening point of bitumen.
11. Determination of Cloud & Pour Points of petroleum products.
12. Detection of Corrosiveness of petroleum products

Outcomes:

The students will be able to handle various apparatus/equipment in determining the physical and transport properties of different petroleum products and also will be able to analyze the various products of petroleum components.

University College of Engineering Kakinada (A), JNTUK
III Year B. Tech. Petroleum Engineering– II Semester

DRILLING SIMULATION LAB

Learning Objectives:

i. Drilling simulation lab familiarizes student not only the normal drilling operations but also abnormal conditions in drilling.
ii. The student can get acquaintance with the drilling operations preventing abnormal conditions like Wall kicks, Blowouts, Mud losses etc.
    The student can have the knowledge how to handle the BOP, Panels, Choke manifold, Remote panel etc., in case of any emergency situation.
iii. Drilling simulation lab covers all abnormal drilling operations that help the student to have total knowledge of the drilling in live conditions.

The following experiments are to be carried out using a drilling simulator:

1. **Familiarization and line-up of operational components – I**: Sand pipe manifold, draw work console, drilling console.
2. **Familiarization and line-up of operational components – II:** Blow out preventor (BOP) panel, choke manifold, remote panel.
3. **Operation of major components:** Mud pumps, operating slow circulation rate, operating the rotary table, pulling weight on bit running in and pulling out of hole, remote choke panel operating.
4. **Kick identifications and well shut in procedures:** Setting flow alarms (deviation mud volume), setting flow alarms for return mud volume, identifying kick warning signs, Utilizing shut in procedures to kill well, well control computations.
5. Studies on the effect of weight on drill bit and rotary speed on the rate of penetration and wear of the bit.
6. Studies on the effect of mud density and flow rate on the penetration and wear of the bit.

Outcomes:

The student will be able to:

i. Familiarizewith abnormal drilling operations and handle any drilling situation without any panic.
ii. Be conversant with the BOP, control panel, remote control panel etc.
iii. To identify the abnormal activities much in advance and plan to prevent the Kick, Blowout etc.
iv. Become a very good drilling engineer by improving the rate of drilling even in critical conditions.

University College of Engineering Kakinada (A), JNTUK
III Year B. Tech. Petroleum Engineering– II Semester

SUMMER TRAINING (4–6 WEEKS)

Every Student should undergo summer training (summer internshipprogram) in a petroleum oil & gas producing industry/ petroleummachinery manufacturing industry for 4-6 weeks and submit a report.

Learning Objectives: The student is guided (through the Industry representative) to learn the following aspects:

- Application of the engineering skills, learned in class room, in real world.
- Working as a team to deliver the results along with senior engineering professionals, technicians, managers etc.
- Work safely in industrial environment.
- Result oriented approach in plant operation, troubleshooting and engineering work.
- Present and / or report the work / project outcomes to various disciplines, departments & interest groups with confidence.

Outcomes: The student shall be able to independently carryout the following tasks:

- Work safely in Industrial environment.
- Work with various interest groups, disciplines, professionals, managers, technicians etc.
- Polish the engineering skills by applying the knowledge in day-to-day operation, trouble-shooting and minor-modifications.
- Building relations with University and Industry that will help mutual cooperation over long-term.

R – 13: Petroleum Engineering
4th Year I – Semester Syllabus

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering– I Semester

INTEGRATED ASSET MANAGEMENT

Learning Objective:
The students will learn the general principles of asset management, integrated petroleum, reservoir management and integrated oil & gas asset management.

UNIT-I
Asset Management: The corporate dimension – Data gathering – Interpreting the main data.

UNIT-II
Developing a decision making frame work: Populating asset management plans – Creating a strategic outline business case for investment – The corporate asset management plan.
Developing an integrated asset management and capital planning system: Overview.

UNIT-III
Reservoir management concepts – Reservoir management process – Data acquision, analysis and management.

UNIT-IV
Reservoir performance analysis and forecast – Reservoir management economics – Reservoir management case studies.

UNIT-V
Industrial asset management strategies for the oil and gas sector: Over view of onshore and offshore assets – Integration and optimization methodology – A case study in OPEX of the assets – Evaluation of asset performance.

UNIT-VI
An asset management model – Typical oil field workflow – Workflows for asset management – An automated approach to data quality management – Change management.

Outcomes:
The students will be able to understand the working principles of an oil and gas asset management. They will be able to optimize the functions of each segment of an asset.

Text Books:
1. A guide to Asset Management and Capital Planning in Local authorities, CIPFA, 2008.
2. The Big Picture: Integrated Asset Management Cedric Bouleau et al, Oil field Review, 2007/2008.
3. Integrated Petroleum Reservoir Management, A team approach, AbdusSatter and Ganesh C. Thakur, Pennwell Books, Tulsa, 1994.

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering– I Semester

ENHANCED OIL RECOVERY TECHNIQUES

Learning Objectives:

- Understanding of secondary / tertiary recovery of crude oils of specific reservoirs
- Following the selection criteria to which reservoir suits for a specific EOR techniques.
- He must be a knowledge of reservoir and production of that particular field
- Post project monitoring is also essential
- Knowledge of maintenance of injection wells / Production wells is essential.
- Knowledge of ignition of injection wells is preferable in case of thermal EORs
- Knowledge of handling of chemicals like CO_2, Surfactants, Polymers etc. is essential
- Handling of injection wells in case of any leakage or blowout situations.

UNIT-I

Introduction: Oil recovery processes.

Gas injection: Introduction- Predictive performance- Gas injection in carbonate reservoirs- Inert gas injection- Candidates for gas injection.

Miscible flooding: Introduction- Sweep efficiency- High pressure gas injection- Enriched gas drive- LPG slug drive- Predictive technique- Field applications.

UNIT-II

Carbon dioxide flooding: Process description- Field projects- CO_2 sources- problem areas- designing a CO_2flood- Guidelines for selection of miscible CO_2 projects- Immiscible CO_2 flooding Conclusions.

Polymer flooding: Introduction- Polymer products and theory of use- Planning polymer flood projects.

UNIT-III

Polyacrylamides: Introduction- Polyacrylamides chemistry- Application of PAM/AA in enhanced oil recovery- Factors affecting flow in porous media- Field considerations- Site factors- Field operation.

Alkaline flooding: Introduction- Types of caustic used- Entrapment of residue oil- Displacement mechanisms in alkaline flooding- Crude oil properties-Alkali consumption- pH of injected caustic- Effect of sodium ions and sodium chloride- Effect of divalent ions- Reservoir selection- Documented alkaline flooding field's tests.

UNIT-IV

Use of surfactants in oil recovery: Introduction- Classification of EOR surfactants- Mechanism of oil displacement by surfactant flooding- Ultra low interfacial tension in relation to oil displacement by surfactant flooding- Factors influencing oil recovery- Surfactant gas flooding for oil recovery- Interfacial phenomena in surfactant gas flooding- Mechanism of surfactant loss in porous media- Present status of the use of surfactants in oil recovery.

UNIT-V

Steam flooding for enhanced oil recovery: Introduction- Theory- Screening criteria for steamflood prospects- Reservoir rock and fluid properties- heat losses and formation heating- oil recovery calculations- An overview of steamflood modeling, parametric studies in steam flooding- Economics of the steam flooding process.

In-situ combustion technology: Introduction-Reservoir characteristics- Ignition- Ignition methods, Process In-situ Combustion- Use of In-situ Combustion- conclusions- Current status of In-situ Combustion.

UNIT-VI

Microbial enhanced oil recovery: Microorganisms- Historical development of microbial enhancement of oil recovery- Laboratory experiments show the potential of microbial enhancement oil recovery- Field application of microbial enhancement of oil recovery-Microbes associated with oilfield problems- Microbial interactions with produced oil-Potential of microbial enhancement of oil recovery-Injection of cells and spores.

Environmental factors associated with oil recovery: Introduction-Primary and secondary production-Chemical flooding-Micellar-polymer processes- Thermal processes- Gas flooding-Research.

Outcomes:

- The student can have the knowledge of that specific reservoir before designing of any EOR project.
- He can be a very good team member in the multidiscipline team where key decisions can be taken in this project work
- He can be a very good operator and maintance engineer of EOR Techniques.
- He can also take all safety precautions while handling of various types of chemicals used in EOR
- He can be a good reservoir manager / production engineer in monitoring the reservoir after post project activities.
- He can be a very good production engineer in handling of hot oils / flue gases etc.
- He can also very well handle these wells during work over operations.

Text Books:

1. Enhanced Oil Recovery: Processes and Operations, E. C. Donaldson, G. V. Chilingarian, T. F. Yew, Elsevier, 1998.
2. Enhanced Oil Recovery, Larry W. Lake, Prentice Hall, 1998.

Reference Books:

1. Basic Concepts in Enhanced Oil Recovery Processes, Marc Baviere, SCI, 1991.
2. Enhanced Oil Recovery: Proceedings of the Third European Symposium on Enhanced Oil Recovery, F. John Fayers, Elsevier, 1981.
3. Enhanced Oil Recovery, Marcel Latil, Editions Technip, 1980.
4. Fundamentals of Enhanced Oil Recovery, H. R. Van Pollew and Associates, PennWell, 1980.
5. Enhanced Recovery of Residual and Heavy Oil, M. M. Schumacher, Noyes Data Corp., 1980.

6. Applied Enhanced Oil Recovery, Aural Carcoane, Prentice Hall, 1992.
7. Recent Advances in Enhanced Oil and Gas Recovery, IstvanLaktos, Academy Kiado, 2001.
8. Enhanced Oil Recovery, Don W. Greew, G. Paul Willfite, Society of Petroleum Engineers, 1998.
9. Enhanced Oil Recovery: Field Planning and Development Strategies, Vladmir Alvarado, Eduardo Marriglee, Gulf Professional Publishing, 2010.
10. Modern Chemical Enhanced Oil Recovery: Theory and Practice, Gulf Professional Publishing, 2011.
11. Enhanced Oil Recovery, Teknica, Teknica Petroleum Services Ltd., 2001.

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering– I Semester

HSE & FE IN PETROLEUM INDUSTRY

Learning Objectives:

- Knowledge of environment issues and all related Acts.
- Knowledge of drilling fluids and its toxic effects with environment.
- Proper disposal of drilling cutting after appropriate treatment.
- Treatment of produced water and makeup water and its disposal as per state pollution control board norms.
- Knowledge of oil mines regulations and proper implementation in drilling & production mines as per Act.
- Knowledge of Hazop in drilling rigs & production installations.
- Knowledge of disaster management to fight any fire accident at drilling rig/ production installation/production platform.

UNIT-I

Introduction to environmental control in the petroleum industry: Overview of environmental issues- A new attitude.
Drilling and production operations: Drilling- Production- Air emissions.

UNIT-II

The impact of drilling and production operations: Measuring toxicity- Hydrocarbons- Salt- Heavy metals- Production chemicals- Drilling fluids- Produced water- Nuclear radiation- Air pollution- Acoustic impacts- Effects of offshore platforms- Risk assessment.
Environmental transport of petroleum wastes: Surface paths- Subsurface paths- Atmospheric paths.
Waste treatment methods: Treatment of water- Treatment of solids- Treatment of air emissions.

UNIT-III

Oil mines regulations: Introduction-Returns, Notices and plans- Inspector, management and duties- Drilling and workover- Production- Transport by pipelines- Protection against gases and fires- Machinery, plants and equipment- General safety provisions- Miscellaneous.

UNIT-IV

Toxicity, physiological, asphyxiation, respiratory, skin effect of petroleum hydrocarbons and their mixture- Sour gases with their threshold limits- Guidelines for occupational health monitoring in oil and gas industry. Corrosion in petroleum industry- Additives during acidizing, sand control and fracturing.

UNIT-V

Hazard identification- Hazard evaluation- Hazop and what if reviews- Developing a safe process and safety management- Personal protection systems and measures.

Guidelines on internal safety audits (procedures and checklist)- Inspection & safe practices during electrical installations- Safety instrumentation for process system in hydrocarbon industry- Safety aspects in functional training-Work permit systems.

UNIT-VI

Classification of fires- The fire triangle- Distinction between fires and explosions- Flammability characteristics of liquids and vapors- Well blowout fires and their control- Fire fight equipment- Suppression of hydrocarbons fires.

Outcomes:

- The student can have the knowledge of various Acts related to safety, Health and environment in petroleum industry.
- The student can have the knowledge of various drilling fluids handling and safe disposal such toxic products.
- Knowledge of disaster management to fight any crisis.
- Knowledge of Hazop studies and occupational health hazards in the industry.

Text Books:

1. Environmental Control in Petroleum Engineering, John C. Reis, Gulf Publishing Company, 1996.
2. Application of HAZOP and What if Reviews to the Petroleum, Petrochemical and Chemical Process Industries, Dennis P. Nolan, Noyes Publications, 1994.
3. Oil Industry Safety Directorate (OISD) Guidelines, Ministry of Petroleum & Natural Gas, Government of India and Oil Mines Regulations-1984, Directorate General of Mines Safety, Ministry of Labor and Employment, Government of India.

Reference Books:

1. Guidelines for Process Safety Fundamentals in General Plant Operations Centre for Chemical Process Safety, American Institute of Chemical Engineers, 1995.
2. Guidelines for Fire Protection in Chemical, Petrochemical and Hydrocarbon Processing Facilities, Centre for Chemical Process Safety, American Institute of Chemical Engineers, 2003.
3. Guidelines for Hazard Evaluation Procedures Centre for Chemical Safety, Wiley-AIChE, 3rd Edition, 2008.
4. Guideline for Process Safety Fundamentals in General Plant Operations, Centre for Chemical Process Safety, AIChE, 1995.

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering– I Semester

PETROLEUM RESERVOIR ENGINEERING-II

Learning Objectives:

To make the students learn fundamentals as well as advanced topics in reservoir engineering like The constant terminal rate solution and its applications to oil well testing, Gas well testing, Natural water influx, Immiscible displacement, Material balance of unconventional gas reservoir, Coal bed methane, Tight gas reservoirs, Gas hydrates.

UNIT-I

The constant terminal rate solution of the radial diffusivity equation and its application to oil well testing: The constant terminal rate solution – Transient, semi steady state and steady state flow conditions – Dimensionless variables – General theory of well testing – The Mathews, Brons, Hazebroek pressure build up theory - Pressure build up analysis techniques – Multi Rate Drawdown testing – The effects of partial well completion – After flow analysis.

UNIT-II

Gas well testing: Linearization and solution of the basic differential equation for the radial flow of a real gas – The Russel, Goodrich etal. Solution technique – The Al Hussainy, Ramey Crowford solution techniques – Non-Darcy flow – Determination of the non- Darcy coefficient F - The constant terminal rate solution for the flow of a real gas – General theory of gas well testing – Multi rate testing of gas wells.

UNIT-III

Pressure build up testing of gas wells – Pressure build up analysis in solution gas drive reservoirs-Analysis of well tests using type curves- Interference and Pulse Tests - Flow after flow tests in gas wells- Isochronal & modified isochronal tests- Use of pseudo pressure in gas well test analysis- Injection Well Testing.

UNIT-IV

Natural water influx: The unsteady state water influx theory of Hurst and Van Everdingen and its application in history matching – The approximate water influx theory of Fetkovich for finite aquifers predicting the amount of mater influx – Application of influx calculation techniques to steam soaking.

UNIT-V

Immiscible displacement: Physical assumptions and their implication – The fractional flow equation – Buckley-Leverette one dimensional displacement – Oil recovery calculation – Displacement under segregated flow conditions – Allowance for the effect of finite capillary transition zone in displacement calculations – Displacement in stratified reservoir.

UNIT-VI

Unconventional Gas Reservoirs: Material Balance Equation for Conventional and unconventional Gas Reservoirs- Coalbed Methane - Tight Gas Reservoirs - Gas Hydrates- Shallow Gas Reservoirs.

Outcomes:

The students will be able to:

i. Learn well pressure build up data as well as pressure withdrawal (drown down) data through these been well testing.
ii. Estimate the reserves of various sands of the reservoir along with water production.
iii. Calculate the formation damage and water in flux, according he can recommend proper stimulation jobs.
iv. Learn the advanced topics like Coal bed methane and Gas hydrates.
v. Recommend for tight gas reservoirs with proper hydro fracturing.
vi. Learn how to acquire the data through well testing in dynamic and closed conditions.
vii. Estimate the long term profiles of the reservoirs.

Text Books:

1. Fundamentals of Reservoir Engineering, L.P. Dake, Elsevier Science, 1978 (17^{th} Impression 1998).
2. Advanced Reservoir Engineering, Tarek Ahmed and Paul D. McKinney, Gulf Professional Publishing, Elsevier, 2005.
3. B. C. Craft – M. Hawkins Applied Petroleum Reservoir Engineering, Third Edition, Revised by Ronald E. Terry & J. Brandon Rogers, Prentice Hall, New York, 2014.

Reference Books:

1. Reservoir Engineering Handbook, Tarek Ahmed, 3^{rd} Edition, Gulf Professional Publishing, 2006.
2. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham &Trotman Inc. 1986.
3. Basic Reservoir Engineering, Rene Cosse, Editions Technip, 1993.
4. Petroleum Reservoir Engineering, James W Amyx, Daniel M. Bass Jr., Robert L. Whiting, McGraw Hill, 1960.

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering– I Semester

Open Elective
OPERATIONAL ASPECTS OF WELL TESTING

Learning Objectives:

i. It deals mainly initial well testing as soon as drilling completes.
ii. The course explains mainly various mobile testing equipment depending on the pay zone available.
iii. It also explains all safety precautions while testing of the wells even with hydrogen sulphide (H_2S).
iv. It also recommends the well completion design based on the initial well test data on zone wise.
v. It explains safe practice of well testing with the surface equipment and also subsurface safety system with high pressure and high temperature wells.
vi. It also deals activation methods, stimulation methods after suitable preformation of the zone.

UNIT-I:

Well testing recommended practices: well test objectives - the decision to test mobilizing test equipment; safety procedures - breathing apparatus, certification, service testing and safety review, hazop studies, dangerous substances- mercury, daylight/high visibility working, explosives -use of explosivesradio silence, secondary isolation systems (downhole switch), responsibility for explosives, storage of explosives.firefighting equipment, gas detection. hydrogensulphide- testing limitations with H_2S, sampling for H_2S,emergency contingency measures.

UNIT- II:

Restricted access, safety meetings- pretest considerations, personnel briefing, oil and drilling supervisors checklist. site preparation, start of testing operations; Job responsibilities during well testing; specific well test objectives – boundaries, flow rate, maximum rate testing, permeability, horizontal, vertical; reservoir pressure, samples – hydrocarbons,solids,water,onsite chemistry zonal contribution, test design .

UNIT-III:

Completion (packer) fluids- cost, formation pressure, formation temperature, fluid detenoration with time, overbalance perforating, underbalance perforating, skin damage, downhole test equipment, perforating.

UNIT-IV:

Downhole Test Equipment;Pressure Gauges, Sub Sea Equipment- Sub Sea Test Tree (SSTT), Associated Sub Sea Equipment, DST Operating Criteria, Sub Sea Test Tree Disconnect; Surface Test Equipment; Surface Test Tree (Flowhead), Choke manifold; Steam Heat Exchanger or Heater; Horizontal Separator; Vertical Separator; Metering; Electronic Surface Data Acquisition; Gauge Tank

UNIT-V:

Well Testing Operations-Equipment Checking, Choke Manifold During Testing, Separator Operations, Production Problems, WellControl, Reservoir Fluid Behaviour & Sampling Operations- Reservoir Fluid Behaviour, Surface Sampling Points-Gas Line , Oil Line ,Wellhead, Monophasic Surface Sampling , Recombination Sampling, Labelling of Samples, Storage and Disposal of Samples; Gas Measurements and Analysis, Oil Measurements and Analysis, Water Measurements and Analysis.

UNIT-VI:

Reporting- Daily Reporting From The Wellsite, Final Well Test Report; Coil Tubing And Nitrogen-Coiled Tubing Equipment, Uses of Coil Tubing; Typical Coil Tubing Operating Procedures; Uses of Nitrogen- Equipment, Nitrogen Commingled with Treating Fluids; Nitrogen Gas as a Displacement or Pressuring Medium; Uses of the Coil Tubing Nitrogen Combination- Gas Lifting , Acidizing , Sand Clean-outs, Stimulation-Responsibilities, Safety, Stimulation by Acid, Stimulation by Fraccing.

Outcomes:

i. The student can become a good well testing engineer.
ii. Safety practice at site and pre-safety meeting etc., make the operation safe while dealing with some hazardous chemicals, high pressure surface lines etc.
iii. He can also very well recommend the design of the initial well completion based on the initial well test data. And he can associate with the well completion team.
iv. He can also co-ordinate with well service team to get complete stimulation jobs during initial testing (N_2& CTU etc.)

Text Book:

1. Operational Aspects Of Oil And Gas Well Testing, Stuart McAleese, ELSEVIER, 2000

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering – I Semester

Open Elective
OIL FIELD CHEMICALS

Learning Objectives:

1. This is course brings awareness of several types of chemical that are used in petroleum industry.
2. This course covers various types of chemicals used in drilling operations and production operations. Thus, the student can have the knowledge of the total oil field chemicals.
3. This is a specialized course where a student can also utilize this knowledge in bulk procurement of similar chemicals and issue to concern department on requirement.
4. The students will get adequate knowledge in screening the chemicals for a particular use in petroleum operations.

UNIT – I:

Drilling Muds: Classification of Muds, Mud Compositions, Additives, Cuttings Removal by Sweep Materials, Junk Removal, Drilling Fluid Disposal, Characterization of Drilling Muds.
Fluid Loss Additives: Mechanism of Action of Fluid Loss Agents, Polysaccharides, Synthetic Polymers.
Clay Stabilization: Properties of Clays, Mechanisms Causing Instability, Inhibitors of Swelling, Chemicals in Detail.
Bit Lubricants: Refractory Metals, Natural Compounds.

UNIT – II:

Bacteria Control: Mechanisms of Growth, Treatments with Biocides, Bactericides, Various Biocides, Bacterial Corrosion, Assessment of Bacterial Corrosion, Mechanisms of Microbial Corrosion.
Corrosion Inhibitors: History, Classification of Corrosion Inhibitors, Fields of Application, Application Techniques, Analytic Procedures, Side Effects, Amides and Imidazolines, Nitrogenous Bases with Carboxylic Acids, Nitrogen Quaternaries, Polyoxylated Amines, Amides, and Imidazolines, Nitrogen Heterocyclics, Carbonyl Compounds, Phosphate Esters, Silicate-based Inhibitors, Miscellaneous Inhibitors.

UNIT – III:

Scale Inhibitors: Scale Inhibition, Mathematical Models, Chemicals in Detail, Characterization,
Gelling Agents: Basic Mechanisms of Gelling Agents.
Filter-cake Removal: Organic Acids, Bridging Agents, Enzymatic Breaker, Peroxides, Oligosaccharide, Oscillatory Flow.
Cement Additives: Basic Composition of Portland Cement, Special Cement Types, Classification of Cement Additives, Additives in Detail.

UNIT – IV:

Transport: Pretreatment of the Products, Corrosion Control, Paraffin Inhibitors, Pour Point Depressants, Drag Reducers, Hydrate Control, Additives for Slurry Transport, Additives for Odorization, Cleaning.
Drag Reducers: Operating Costs, Mechanism of Drag Reducers, Drag Reducers in Detail

Gas Hydrate Control: The Relevance of Gas Hydrates, Inclusion Compounds, Clathrates, Conditions for Formation, Formation and Properties of Gas Hydrates, Inhibition of Gas Hydrate Formation, Hydrate Inhibitors for Drilling Fluids.
Antifreeze Agents: Theory of Action-colligative Laws, Overview of Antifreeze Chemicals, Heat-transfer Liquids, Hydraulic Cement Additives, Pipeline Transportation of Aqueous Emulsions of Oil, Low-temperature Drilling Fluids.
Odorization: Additives for Odorization, Measurement and Odor Monitoring, Uses and Properties.

UNIT – V:
Enhanced Oil Recovery: Waterflooding, Caustic Waterflooding, Acid Flooding, Emulsion Flooding, Chemical Injection, Polymer Waterflooding, Combination Flooding, Foam Flooding, Carbon Dioxide Flooding, Steamflooding, In Situ Combustion, Special Techniques, Microbial-enhanced Oil-recovery Techniques, Reservoir Properties, Soil Remediation.
Hydraulic Fracturing Fluids: Stresses and Fractures, Comparison of Stimulation Techniques, Basic Constituents, Types of Hydraulic Fracturing Fluids, Characterization of Fracturing Fluids, Water-based Systems, Oil-based Systems, Foam-based Fracturing Fluids, Fracturing in Coal-beds, Propping Agents, Acid Fracturing, Special Problems.

UNIT – VI:
Water Shutoff: Basic Principles, Chemicals for Water Shutoff.
Oil Spill-treating Agents: History, Contents.
Dispersants: Cement, Aqueous Drilling Muds, Miscellaneous.
Defoamers: Uses in Petroleum Technology, Classification of Defoamers, Theory of Defoaming.
Demulsifiers: Emulsions in Produced Crude Oil, Waterflooding, Oil Spill Treatment, Desired Properties, Mechanisms of Demulsification, Performance Testing, Classification of Demulsifiers, Chemicals in Detail.

Outcomes:
The students will be able to:

- Become specialists in oil field chemicals.
- Coordinate the departments in an asset in the application of chemicals as additives for specific used in petroleum operations.
- Acquire knowledge to plan and execute appropriate HSE programs.

Text Books:

1. Oil Field Chemicals, Johannes Karl Fink, Gulf Professional Publishing is an imprint of Elsevier Science, 2003

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering– I Semester

Open Elective
SELECTED TOPICS IN PETROLEUM ENGINEERING

UNIT – I:

Specialized Well-Logging Topics: Directional survey and principles – Openhole caliper logs – casing collar locators – Casing inspection logs – Cement evaluation logs – Simultaneous casing inspection and cement evaluation

Borehole imaging – Natural field methods.

UNIT – II:

Emerging Drilling Technologies:

Offshore: Duel gradient Drilling systems

Onshore: Expendables Tubulars – casing drilling – deep hard rock drilling

Meterials: Resin components – metal composites – Microsystems: Fibre – Optic devices – Micradrilling.

UNIT – III:

Offshore Drilling Units: History &Evdution – Rig types, Designs and capabilities – other considerations – classification, Registration and regulations.

UNIT – IV:

Intelligent – Well Completions

Fundamentals of technology: Definitions objectives of intelligent- well flow control, equipment & system requirements, screening criteria, design considerations, layered reservoirs and horizontal wells, multilateral engineering issues, sensors, field development aspects and data handtion operational considerations, field applications and sand control.

UNIT – V:

Well production problems:

Hydrocarbon related problems: Asphallenes – Waxes Water related problems: hydrotes – water – control.

Inorganic – scale formation: phenomenology – scaling economics – coping with scale production – the nature of steels – coping with corrosion.

UNIT – VI:

Subsea &Downhole processing:

Why subsea processing – Existing applications – Process configurations – Design considerations – Technology components – Profitability.

Downhole Processing: What is downhole processing? – Historical perspective – Technology fundamentals – Screening criteria – Field applications – operational considerations.

Text Books:

1. Specialized well logging topics in Reservoir Engineering and petrophysics, vol V, Larry W Lake, SPE, 2007.
2. Well Production problems in production operations engineering vol 4.
3. Intelligent well completions & subsea and downhole processing in vol VI
4. Emerging Drilling Technologies and offshore drilling units in Vol II, Drilling Engineering of Petroleum Engineering Handbook, Editor in Chief Larry W Lake, SPE, 2007

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering– I Semester

Elective-I
OFFSHORE ENGINEERING

Learning Objectives

- Introduce different types of deep water offshore structures and challenges
- Introduce Concept of wave theory for linear and nonlinear waves.
- Estimation of wave loads on small and large bodies
- Estimation different types of loads on offshore structures such as gravity, wind, wave and current loads
- Detailed design of fixed offshore structures
- Concepts of floating structures
- Fundamental aspects of semisubmersible, TLP, spar and installation methodologies
- Design aspects of risers

UNIT-I

Overview of offshore structures: Introduction- Deepwater challenges- Functions of offshore structures- Offshore structure configurations- Bottom-Supported fixed structures- Compliant structures- Floating structures- Classification societies and industry standard groups.

Novel and small field offshore structures: Introduction- Overview of oil and gas field developments- Technical basis for developing novel offshore structures- Other considerations for developing novel offshore structures- Novel field development systems- Future field development options.

UNIT-II

Ocean environment: Introduction- Ocean water properties- Wave theory- Breaking waves- Internal waves- Sea spectrum- Sea states- Wave-driven current- Loop current- wind and wind spectrum- Offshore environment by location.

Loads and responses: Introduction- Gravity loads- Hydrostatic loads- Resistance loads- Current loads on structures- Steady and dynamic wind loads on structures- Wave loads on structures- Applicability of Morison force vs Diffraction force- Steady wave drift force- Slow-Drift wave forces- Varying wind load- Impulse loads- Response of structure- Applicability of response formula.

UNIT-III

Fixed offshore platform design: Field development and concept selection activities- Basic and detailed design of a fixed jacket.

UNIT-IV

Floating offshore platform design: Introduction- Floating platform types- Design of floaters- Floating production storage and offloading systems.

UNIT-V

Semi submersibles- Tension leg platforms- Spar design- Hull structure- Construction and installation.

Fundamental aspects of the design of FPSO.

UNIT-VI

Drilling and production risers: Drilling risers- Production risers- Vortex induced vibration of risers-Design aspects.

Outcomes

The student will be able to:

- Identify type of offshore structure and recommend a specific offshore structure for a given site condition and requirements of the platform.
- Estimate water particle kinematics using linear Airy's wave theory and estimate maximum wave force and overturning moment for a fixed vertical circular cylinder.
- Use of diffraction theory for a large body
- Analysis and design of fixed offshore structure
- Perform mass distribution of different structures such as floating structure, TLP and Spar.
- Design aspects of Risers

Text Book:

1. Handbook of Offshore Engineering, S. Chakrabarti, Volume 1 & 2, Elsevier, 2005.

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering– I Semester

Elective-I
PIPELINE ENGINEERING

Learning Objectives:

- Operations and maintenance of flow lines or trunk pipe lines.
- Understanding of well fluids for proper designing of flow lines/trunk pipe lines.
- Obtaining the permissions to laying of pipe line as per the State/DGMS regulations.
- Operation and maintenance of gas compressors
- Handling of flammable fluids like gas, oil condensate to check the accident free operation.
- Protection from internal/external corrosion of pipe lines by suitable methods.

UNIT-I:

Elements of pipeline design: Fluid properties – Environment - Effects of pressure and temperature - Supply / Demand scenario - Route selection - Codes and standards - Environmental and hydrological considerations – Economics - Materials / Construction – Operation - Pipeline protection - Pipeline integrity monitoring.

Pipeline route selection, survey and geotechnical guidelines: Introduction - Preliminary route selection - Key factors for route selection - Engineering survey - Legal survey - Construction / As-built survey - Geotechnical design.

UNIT-II:

Natural gas transmission: General flow equation – Steady state - Impact of gas molecular weight and compressibility factor on flow capacity - Flow regimes - Widely used steady-state flow equations – Summary of the impact of different gas and pipeline parameters on the gas flow efficiency – Pressure drop calculation for pipeline in series and parallel – Pipeline gas velocity – Erosional velocity – Optimum pressure drop for design purposes – Pipeline packing – Determining gas leakage using pressure drop method – Wall thickness / pipe grade – Temperature profile – Optimization process – Gas transmission solved problems.

UNIT-III:

Gas compression: Types of compressors – Compressor drivers – Compressor station configuration – Thermodynamics of isothermal and adiabatic gas compression – Temperature change in adiabatic gas compression – Thermodynamics of polytropic gas compression – Gas compressors in series – Centrifugal compressor horsepower – Enthalpy / Entropy charts (Mollier diagram) – Centrifugal compressor performance curve- Reciprocation compressors.

Coolers : Gas coolers – Air-cooled heat exchangers –Heat transfer equations for coolers – Fan air mass flow rate – Required fan power – Gas pressure drop in coolers – Iterative procedure for calculations based on unknown T_2.

UNIT-IV:

Liquid flow and pumps: Fully developed laminar flow in a pipe – Turbulent flow – Centrifugal pumps – Retrofitting for centrifugal pumps (Radial-flow) – Pump station control – Pump station piping design.

Transient flow in liquid and gas pipelines: Purpose of transient analysis – Theoretical fundamentals and transient solution technique – Applications – Computer applications.

UNIT-V:

Pipeline mechanical design: Codes and standards – Location classification – Pipeline design formula – Expansion and flexibility – Joint design for pipes of unequal wall thickness – Value assemblies – Scraper traps – Buoyancy control – Crossings – Depth of cover – Aerial markings – Warning signs.

Pipeline construction: Construction – Commissioning.

UNIT-VI:

Materials selection: Elements of design – Materials designation standards

Pipeline protection, Instrumentation and Pigging: Pipeline coating – Cathodic protection – Cathodic protection calculations for land pipelines – Internal corrosion – Flow meters and their calibration – Sensors – Pigs.

Outcomes:

- The student can be a specialist in pipeline designing, pipe line maintenance.
- Repair and maintenance of pipeline in short time to avoid production loss.
- He can plan for suitable corrosion protection methods to improve the life of the pipeline.
- He can be a good public relations officer when he deals with public to acquire the land & also during repair & maintenance operations.

Text Books:

1. Pipeline Design and Construction: A Practical Approach, M. Mahitpour, H. Golshan and M.A. Murray, 2nd Edition, ASME Press, 2007.
2. Pipeline Engineering, Henry Liu, Lewis Publishers (CRC Press), 2003.

Reference Books:

1. Piping Calculation Manual, E. ShashiMenon, McGraw-Hill, 2004.
2. Piping and Pipeline Engineering: Design, Construction, Maintenance Integrity and Repair, George A. Antaki, CRC Press, 2003.
3. Pipeline Planning and Construction Field Manual, E. ShashiMenon, Gulf Professional Publishing, 2011.
4. Pipeline Rules of Thumb Handbook, E. W. McAllister, 7th Edition, 2009.
5. Liquid Pipeline Hydraulics, E. ShashiMenon, Mareel Dekker, Inc., 2004.
6. Gas Pipeline Hydraulics, E. ShashiMenon, Taylor & Francis, 2005.

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering – I Semester.

Elective –I
COAL BED METHANE ENGINEERING

Learning Objectives:
This course introduces the student the basics of coal bed methane by giving an overview of reservoir, drilling, production.
This course makes the student to

- Have overview of scenario of CBM
- Have knowledge on the geology of coal
- Deal with basic principles of sorption and isotherms
- Analyze reservoir characterizes of CBM
- Have basic idea of completions and driving of CBM reservoirs
- Understand the hydrofrac job for coal seams
- Learn in dealing with water from production and disposal.

UNIT-I
Introduction: Overview of coal bed methane (CBM) in India – CBM vs conventional reservoirs.

UNIT-II
Geological influences on coat formation of coals – Coal chemistry – Significance of rank – Cleat system and natural fracturing.

UNIT-III
Sorption:Principles of Adsorption-The Isotherm construction-CH_4 retention by coal seams-CH_4 content determination in coal seams-The isotherm for recovery prediction-Model of the micro-pores-coal sorption of other molecular species.

UNIT-IV
Reservoir Analysis:Coal as a reservoir-Permeability-Porosity-Gas flow-Reserve analysis-Well spacing and drainage area-Enhanced recovery.

UNIT-V
Well Construction:Drilling-Cementing.
Formation Evaluations, Logging:Borehole environment-Tool measurement response in coal-wire line log evaluation of CBM wells-Gas-In-Place calculations-Recovery factor-Drainage area calculations-Coal permeability/Cleating-Natural fracturing and stress orientation-Mechanical rock properties in CBM evaluation.
Completions:Open hole completions-Open hole cavitation process, Cased hole completions-Multi zone entry in cased hole.

UNIT-VI
Hydraulic fracturing of coal seams:Need for fracturing coals-Unique problems in fracturing coals-Types of fracturing fluids for coal-In situ conditions-Visual observation of fractures.

Water production and disposal:Water production rates from methane wells-Chemical content-Environmental regulations-Water disposal techniques-Economics of coal bed methane recovery.

Outcomes:

By successful completion of this course, the will be able to

- Master the fundamentals of coal bed methane
- Construct different isotherms
- Evaluate different logs for CBM reservoirs
- Have good knowledge on water disposal techniques and environmental laws
- Understand reservoir drilling production of CBM
- Design a CBM reservoir

Text Books:

1. Coal Bed Methane: Principles and Practice, R. E. Rogers, 3rd Edition, Prentice Hall, 1994.
2. Coal Bed Methane, Robert A. Lamarre, American Association of Petroleum Geologists, 2008.

Reference Books:

1. Fundamentals of Coal Bed Methane Reservoir Engineering, John Seidle, Pennwell Corp., 2011.
2. Coal Bed Methane, Society of Petroleum, 1992.
3. A Guide to Coal Bed Methane Operations, B. A. Hollub, Society of Petroleum, 1992.

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering – I Semester.

PETROLEUM EQUIPMENT DESIGN & SIMULATION LAB

Learning Objectives: The student will be trained in the following fundamentals:

- Characterization of Petroleum fractions by combining hydrocarbon light-ends (represented by pure components) and heavy- ends (represented by distillation cuts) to generate pseudo-components i.e., input data
- Application & understanding of suitable Thermodynamic models for predicting the properties of various hydrocarbons, sour systems & electrolytes.
- Creation of suitable flow chart with pipe segments, valves, mixers, splitters, flash drums, two / three phase separators, reactors, columns, heat exchanges, columns and various other unit operations for the give application.
- Steady state simulation of the plant /equipment & hydraulic systems for (a) performance prediction / adequacy check called "rating" and (b) and for design purpose called 'sizing"
- Generate output date files with stream data (heat & material balance), equipment duty / design features, hydraulic capacity etc.

The following experiments have to be conducted using C/C++/ Simulink using MATLAB/UNISIM:

1. Oil- Water separator.
2. Gas- Oil-Water separator.
3. Lean / rich amine heat exchanger.
4. Air cooled heat exchanger.
5. CO2 and H2S absorber unit using, MEA/DEA amine solution.
6. Stripping unit.
7. Single stage flash vaporization unit.
8. Three stage flash vaporization unit.
9. Liquid pumping system & simulation of water-hammer phenomena.
10. Gas Compressor unit.

Outcomes: The student shall be able to carry-out the following tasks independently:

- Create input file for given raw data (pure components & distillation cuts) by appropriate pseudo-cut, thermodynamic model selection for hydrocarbon & sour applications
- Create additional components suitable for usage of Utility streams (Steam, Boiler Feed water, Air etc.) as appropriate for the requirement.
- Simulate a process plant using a basic process flow diagram /scheme by building a simulation flow chart /environment and converging the model (a) reflecting the actual plant operating conditions, while rating and /or troubleshooting and (b) meeting the desired objectives, while designing or sizing.
- Use three-phase separation / decant techniques for moisture bearing hydrocarbons as appropriate.

- Use appropriate tray efficiencies (from literature) for various distillation applications and optimizing reflux ratio / Reboiler duties / number of trays for a given product specifications.
- Size /rate the pipeline & pumping systems for liquid pumping & simulate water hammer conditions.
- Carryout detailed thermal sizing or rating of shell & tube exchangers as per TEMA specifications and API guidelines.
- Simulate Gas Compressor (Reciprocating, Centrifugal) Units.
- Generate sized equipment data sheets as per the industry standards with required information for detailed design / manufacture.

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering – I Semester.

PETROLEUM RESERVOIR ENGINEERNG LAB

Learning Objectives:

The students are made to understand experimental determinations of reservoir (Oil as well as gas) properties such as Porosity, Absolute & Relative permeability, Capillary pressure, Fluid properties like Density, Viscosity and Surface tension etc.

Experiments:

1. Determination of effective porosity by gas expansion method.
   Equipment: Helium porosimeter (Nitrogen gas can be used in place of helium).
1. Determination of porosity and pore size distribution by mercury injection.
   Equipment: Mercury porosimeter.
2. Measurement of surface tension & interfacial tension with the ring tensiometer.
   Equipment: Tensiometer.
3. Determination of fluid density using pycnometer and hydrometer methods.
   Equipment: Pycnometer and hydrometer.
4. Liquid viscosity measurement using capillary tube viscometer (Ostwald type).
   Equipment: Capillary tube viscometer.
5. Determination of capillary pressure of reservoir rock (core) using porous plate method.
   Equipment: Capillary pressure cell.
6. Measurement of contact angle (between oil, water and solid surface) using imaging method.
   Equipment: The image system set-up.
7. Measurement of air permeability.
   Equipment: Constant head permeameter with the Hassler cell.
8. Absolute permeability measurement of water.
   Equipment: The Darcy apparatus.
9. Determination of relative permeability of oil-water using unsteady state method.
   Equipment: Relative permeability apparatus.
10. Determination of relative permeability of gas-oil using unsteady state method.
    Equipment: Relative permeability apparatus.

Outcomes:

i. The student will become conversant in experimental procedures to acquire process, analyze and interpret the reservoir and reservoir fluid data.
ii. This laboratory work makes the students to become good Reservoir Engineers.

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering – I Semester.

PRESENTATION OF SIP REPORT

Learning Objectives:

- To give a clear, organized and accurate oral presentation of Summer Training Report.
- To provide verbally/ through power point presentation of condensed large amounts of technical information into concise, condensed analysis.
- Sharing the practical knowledge obtained during training with fellow students

The presentation of the summer training report by the candidates should be conducted by a committee constituted by the Head of the Department for evaluation.

Summer training report of the students shall be evaluated for 50 marks by the committee appointed by the university.

Outcomes: Students will extend their abilities to

- Get themselves good clarity in the technical topics being presented.
- Develop good communication skills.
- Practice the behaviors of effective speakers.
- Assess strengths in speaking and set goals for future growth.

R – 13: Petroleum Engineering
4thYear II – Semester Syllabus

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering – IISemster.

PETROLEUM ECONOMICS, REGULATIONS & POLICIES

Leaning Objectives:

a) Understand the importance of petroleum sector in the world economy, both the macro and micro Economic environment and as applicable to India.
b) Understand the commercial aspects related to the oil and gas industry value chain from exploration to consumers.
c) Carry out a Project Risk evaluation breakeven and sensitivity analysis and develop a model to know which petroleum projects are worthwhile and which projects should have higher priority
d) To understand the regulations regarding Refining, Processing, Storage, Transportation Distribution, Marketing & Sale of petroleum products.
e) To have an overview of the regulatory frame related to exploration as per NELP.

UNIT-I

Introduction and Role and Value of Oil and Gas-Government and corporate interests- Evolution of national oil companies -Organization of Petroleum Exporting Countries - Political Environment related to Petroleum Industry

UNIT-II

Principles, Methods and Techniques of Petroleum Engineering Economics: Time value in capital expenditures, Depreciation and depletion in oil projects- Financial measures and profitability analysis.

UNIT-III

Analysis of alternative selections and replacements- Risk, uncertainty and decision analysis- Break even and sensitivity analysis- Optimization Techniques.

UNIT-IV

Application and Project Evaluation: Oil fields exploration and drilling operations-Oil fields' estimation of oil reserves and evaluation of an oil property- Project financial analysis. Project development and Joint development utilization Oil fields production operations- Oil transportation- Crude oil processing.

UNIT-V

Demand and Marketing of Petroleum Products. Crude oil fundamentals - Price of crude - Crude oil prices in transactions. Internal Markets and Prices -Marketing and sale of Motor – Aviation – Lubricant -Asphalt and Propane. Transportation: Fundamentals of transportation – Pipelines -Oil tankers - Downstream transportations. Distribution of Petroleum Products.

UNIT-VI

Petroleum or Oil & Gas Policies and Regulations. Petroleum and Oil & Gas Rules and Regulations in India – The Oil fields Regulations and Development Act – New Exploration

Licensing Policy (NELP) – Functions of Directorate General of Hydrocarbons – Petroleum and Natural Gas Regulatory Board.

Outcomes: On completion of the course the students should be able to**:--**

a) Explain the inter relations between Oil industry per se and its impact on national and global economy.
b) Evaluate a strategic policy framework of a firm and comment on its relative position within the industry.
c) Develop the capability to analyze the global oil and gas industry, focusing on its strategic, economic and fiscal position.
d) Demonstrate Decision Making Skills in analyzing basic financial results related to petroleum industry.
e) Capable of analyzing the petroleum industry involving pricing, risk profiling, optimization, and profitability choosing appropriate techniques.
f) Develop generic marketing plans for petroleum products downstream.
g) Understand and apply the regulatory framework related to Petroleum industry in the area of licensing and exploration.

Text Books:

1. Petroleum Economics and Engineering, Third Edition, Hussein K. Abdel-Aal, Mohammed A. Alsahlawi, CRC Press, 2013. (ISBN: ISBN; 1466506660, 9781466506664)
2. The Global Oil & Gas Industry: Management, Strategy and Finance. 2011. Andrew Inkpen (Author), Michael H. Moffett (Author). (ISBN-10: 1593702396, ISBN-13: 978-1593702397)

Reference Textbooks:

1. Petroleum Economics, Jean Masseron, Technip; 4th revised edition (2000) (ISBN-10: 2710805979; □ ISBN-13: 978-2710805977)
   (The instructor can download information required from internet to teach the topics in UNIT VI).

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering – II Semester.

Elective-II
RESERVOIR MODELING & SIMULATION

Learning Objectives:

1. Theoretical and working knowledge of reservoir simulation models of varying complexities:
   a) Single-phase fluid equations in multiple dimensions
   b) Volume finite difference approaches
   c) Block centered grids
   d) Point distributed grids
   e) Well representation
2. Applicable numerical methods for the solution of simple and complex reservoir simulation models. Emphasis shall be towards the general approaches such as direct solution and iterative solution methods.
3. Parametric analysis of reservoir simulation models.

UNIT-I

Introduction: Milestones for the engineering approach-Importance of the engineering and mathematical approaches.

Single-phase fluid equations in multidimensional domain: Properties of single-phase fluid- Properties of porous media- Reservoir discretization- Basic engineering concepts- Multidimensional flow in Cartesian coordinates- Multidimensional flow in radial-cylindrical coordinates.

UNIT-II

Flow equation using CVFD terminology: Introduction- Flow equations using CVFD terminology- Flow equations in radial-cylindrical coordinates using CVFD terminology- Flow equation using CVFD terminology in any block ordering scheme.

UNIT-III

Simulation with a block-centered grid: Introduction- Reservoir discretization- Flow equation for boundary grid blocks- Treatment of boundary conditions- Calculation of transmissibilities- Symmetry and its use in solving practical problems.

UNIT-IV

Simulation with a point distributed grid: Introduction- Reservoir discretization- Flow equation for boundary grid points-Treatment of boundary conditions-Calculation of transmissibilities - Symmetry and its use in solving practical problems.

UNIT-V

Well representation in simulators: Introduction- Single block wells- Multi block wells- Practical considerations dealing with modeling and well conditions.

Single-phase flow equations for various fluids: Pressure dependence of fluid and rock properties-General single-phase flow equation in multi dimensions.

UNIT-VI

Linearization of flow equation: Introduction- Nonlinear terms in flow equations- Nonlinearity of flow equations for various fluids- Linearization of nonlinear terms- Linearized flow equations in time.

Methods of solution of linear equations: Direct solution methods- Iterative solution methods.

Outcomes:

For a given reservoir characterization and assumed geometry, a student with good knowledge of this course shall be able to carry the following tasks:

a) Develop a simple mathematical model to represent the reservoir production capabilities using mathematics and fundamentals of fluid flow.
b) Enhance the complexity of mathematical model to represent realistic reservoir conditions
c) Working knowledge of model solution approaches using mathematical rules such as linearization.
d) Parametric case studies and remedies to bypass numerical instabilities and stiff formulations.

Text Book:

1. Petroleum Reservoir Simulation: A Basic Approach, Jamal H. Abou – Kasem, S. M. Fariuq Ali, M. Rafiq Islam, Gulf Publishing Company, 2006.

Reference Books:

1. Principles of Applied Reservoir Simulation, John R. Fanchi, Elsevier, 2005.
2. Practical Reservoir Simulation, M.R. Carlson, PennWell, 2003.
3. Reservoir Simulation: Mathematical Techniques in Oil Recovery, Zhangxin Chen, Cambridge University Press, 2008.
4. Mathematics of Reservoir Simulation, Richard E. Ewing, Society for Industrial and Applied Mathematics (SIAM), 1983.

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering – II Semester.

Elective-II
HORIZONTAL WELL TECHNOLOGY

Learning Objectives:
This course introduces fundamentals of horizontal wells by dealing with reservoir and production characteristics of horizontal wells and respective challenges
The student will be able to

- Understand the basics of horizontal wells and its reservoir properties.
- Have knowledge of different types of horizontal wells
- Differentiate between horizontal and vertical fractured wells
- Understand the testing and flow performance using different equations
- Gain knowledge on critical rates of flow and challenges during different rates of flow like gas and water coning

UNIT-I
Overview of horizontal well technology: Introduction- Limitations of horizontal wells- Horizontal well applications- Drilling techniques- Horizontal well length based upon drilling techniques and drainage area limitations- Completion techniques.
Reservoir engineering concepts: Skin factor- Skin damage for horizontal wells- Effective wellbore radius r'_w- Productivity index, *f*- Flow regimes- Influence of areal anisotropy.

UNIT-II
Steady-state solutions: Steady-state productivity of horizontal wells- Effective wellbore radius of a horizontal well- Productivity of slant wells- Comparison of slant well and horizontal well productivities- Formation damage in horizontal wells- Field histories.
Influence of well eccentricity: Introduction- Influence of well eccentricity- Drilling several wells- Horizontal wells at different elevations.

UNIT-III
Comparison of horizontal and fractured vertical wells: Vertical well stimulation- Types of fractures- Comparison of horizontal wells and finite conductivity fractures- Horizontal wells in fractured reservoirs- Fractured horizontal wells.

UNIT-IV
Transient well testing: Introduction-Mathematical solutions and their practical implications- Generalized flow regimes- Pressure response- Detailed well testing flow regimes- Pressure directivities- Wellbore storage effects- Practical Considerations.

UNIT-V
Pseudo-steady state flow: Generalized pseudo-steady state equation for vertical wells- Shape factors for vertical wells- Shape factors for fractured vertical wells- Shape factors of horizontal wells- Horizontal well pseudo-steady state productivity calculations- Inflow performance of partially open horizontal wells- Inflow performance relationship (IPR) for horizontal wells in

solution gas-drive reservoirs- Predicting horizontal well performance in solution gas-drive reservoirs.

UNIT-VI

Water and gas coning in vertical and horizontal wells: Critical rate definition- Vertical well critical rate correlations- Critical rate by production testing- Decline curve analysis- Water breakthrough in vertical wells- Vertical well post-water breakthrough behavior- Characteristics of water cut versus recovery factor plots- Water and gas coning in horizontal wells- Horizontal well breakthrough time in a bottom- Water drive reservoir- Breakthrough time for a horizontal well in a reservoir with gas cap or bottom water- Cone breakthrough time for horizontal wells in reservoir with both gas cap and bottom water- Critical rate for horizontal well in edge-water drive reservoir practical considerations- Field Histories.

Outcomes:

After successful completion of this course, the student will be able to

- Have overview of horizontal well technologies
- Perform flow performance calculations of horizontal wells
- Perform mathematical solutions to transient well testing for different flow regimes
- Solve challenges for different flow rates
- Design a horizontal well

Text Book:

1. Horizontal Well Technology, S. D. Joshi, PennWell Publishing Company, 1991.

Reference Book:

1. Horizontal Wells: Formation Evaluation, Drilling and Production Including Heavy Oil Recovery, Roberto Aguilera, G. M. Cordell, G. W. Nicholl, J. S. Artindete, M. C. Nq., Gulf Publishing Co., 1991.

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering – II Semester.

Elective-II
LNG: PROCESSES, TRANSPORTATION & STORAGE

Learning Objectives:

- The course introduces the student different processes, transportation and storage of liquefied Natural gas (LNG).
- The students will be able to-
- Gain basic knowledge of LNG and its prospective.
- Learn different liquification technologies of LNG.
- Have knowledge on different functional units on receiving terminals
- Analyse transportation of LNG and regasification.
- Understand HSE of LNG industry.

UNIT – I: Introduction
Overview of LNG industry: History of LNG industry – Base load LNG – Developing an LNG Project – World and Indian Scenario – Properties of LNG

UNIT – II:
Liquefaction Technologies:
Propane precooled mixed refrigerant process – Description of Air products C_3MR LNG process – Liquefaction – LNG flash and storage.
Cascade process: Description of Conocophillips optimized cascade (copoc) process – Liquefaction – LNG flash and storage.

Other Liquefaction Processes: Description of Linde MFC LNG process- Precooling and Liquefied Petroleum Gas (LPG) recovery – Liquefaction and subcooling- Trends in LNG train capacity – strategy for grassroots plant- offshore LNG production.

UNIT – III
Supporting Functional Units in LNG Plants: Gas pretreatment: Slug catcher – NGL stabilization column – Acid gas removal unit – Molecular sieve dehydrating unit – Mercury and sulfur removal unit – NGL recovery – Nitrogen rejection – Helium recovery.

UNIT – IV
Receiving Terminals: Receiving terminals in India – Main components and description of marine facilities – storage capacity – Process descriptions.
Integration with adjacent facilities – Gas inter changeability – Nitrogen injection – Extraction of C_{2+} components.

UNIT – V
LNG Shipping Industry & Major Equipment in LNG Industry:
LNG Shipping Industry: LNG fleet – Types of LNG ships – Moss – Membrane – prismatic; Cargo measurement and calculations.

Major equipment in LNG industry – Cryogenic heat exchangers: Spiral – Wound heat exchangers – Plate-fin heat exchangers – Cold boxes; Centrifugal compressors – Axial compressors – Reciprocating compressers.
LNG pumps and liquid expanders – Loading Arms and gas turbines.

UNIT – VI

Vaporizers: Submerged combustion vaporizers- Open rack vaporizers – Shell and tube vaporizers: direct heating with seawater, and indirect heating with seawater.
Ambient air vaporizers: Direct heating with ambient air – Indirect heating with ambient air.
LNG tanks.

Safety, Security and Environmental Issues:

Safety design of LNG facilities – Security issues for the LNG industry – Environmental issues – Risk based analysis of an LNG plant.

Outcomes:

- Upon successful completion of this course, the student will be able to-
- Have good knowledge on LNG process
- Classify different liquification techniques
- Understand different units in LNG processing and transportation
- Have knowledge associated with safety aspects of LNG

Text Book:

1. LNG: Basics of Liquified Natural Gas, I st Edition, Stanley Huang, Hwa Chiu and Doug Elliot, PETEX, 2007
   https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook_demos/lng/HTML/index.html

Reference Books:

1. Marine Transportation of LNG (Liquefied) and related products, Richard G. Wooler, Gornell Marine Press, 1975.
2. Marine Transportation of Liquefied Natural Gas, Robert P Curt, Timothy D. Delaney, National Maritime Research Centre, 1973.
3. Natural Gas by Sea: The Development of a New Technology, Roger Rooks, Wither by, 1993.
4. Natural Gas: Production, Processing and Transport, Alexandre Rojey, Editions OPHRYS, 1997.
5. LNG: A Nontechnical Guide, Michael D'Tusiani, Gordon Shearer PennWell Books, 2007.
6. Natural Gas Transportation, Storage and Use, Mark Fennell Amazon Digital Services, Inc., 2011.
7. Liquefied Natural Gas, Walter Lowenstein Lom, Wiley 1974.
8. Liquefied Natural Gas, C. H. Gatton, Noyes, 1967.
9. Liquified Gas Handling Principles on Ships and in Terminals, 3rd Edition, McGuire and White, Witherby Publishers, 2000

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering – II Semester.

Elective-III
RESERVOIR STIMULATION

Learning Objectives:

- Basic concepts of rock mechanics and their relevance to design a stimulation task in a petroleum reservoir
- Development and analysis of Simple 2D, Psuedo 3D and Real 3D analytical models to represent hydraulic fracturing.
- Working knowledge of fracturing fluids and their additives
- Working knowledge of the rheology of fracturing fluids and their properties
- Data requirements for the design of a fracturing task.
- Pressure decline analysis and interpretation techniques
- Practical limitations in fracture design
- Prediction of fracture height and various approaches for post-treatment measurements
- Evaluation of post treatment and performance of fractured wells

UNIT-I

Reservoir justification of stimulation treatments: Introduction- Fundamentals of pressure transient analysis- Well and reservoir analysis.
Elements of rock mechanics: Basic concepts- Pertinent rock properties and their measurement- In-Situ stress and its determination.

UNTI-II

Modeling of hydraulic fractures: Conservation laws, and constitutive equations- Fracture propagation models- Fluid-Flow modeling- Acid fracturing.
Fracturing fluid chemistry: Water-Base fluids- Oil-Base fluids- Multiphase fluids- Additives- Execution.

UNIT-III

Fracturing fluid proppant and characterization: Rheology- Shear and temperature effects on fluid properties- Foam fracturing fluids- Slurry rheology- Proppant transport- Fluid loss- Formation and fracture damage- Proppants.
Pre-Treatment data requirements: Types of data- Sources of data- Dynamic downhole testing.

UNIT-IV

Fracturing diagnosis using pressure analysis: Basic relations- Pressure during pumping- Analysis during closure- Combined analysis pumping and closure- Field procedures.
The optimization of propped fracture treatments: Physical systems and mathematical formulations- Treatment optimization design procedure- Parametric studies of fracture design variables.

UNIT-V

Considerations in fracture design: Size limitations- Considerations with predetermined size or volume- Benefits of high proppant concentrations- Effect of reservoir properties- Effects of perforations on fracture execution.

Fracture-Height predictions and post-treatment measurements: Linear fracture-mechanics modeling for fracture height- Fracture-height prediction procedures- Techniques to measure fracture height.

UNIT-VI

Post-treatment evaluation and fractured well performance: Selected references before the finite conductivity fracture models- Cinco and Samaniego model- Comments on damaged and chocked fractures- Post-fracture well analysis- Interpretation for finite conductivity fracture wells with wellbore storage- Comparison of production forecasts for untreated and fractured wells- Calculation of the fracture length and conductivity of long-flowing wells.

Outcomes:

- Working knowledge of various approaches of fracturing approaches
- Assimilate data for the design of stimulating treatment
- Design and analyze fracturing approaches for petroleum reservoir stimulation.
- Solve practical problems in reservoir fracturing and remedies to resolve the same.

Text Book:

1. Reservoir Stimulation, Michael. J. Economides, Kenneth G. Nolte, 2nd Edition, Prentice Hall, 1989.

Reference Books:

1. Oil Well Stimulation, Robert S. Schechter, Prentice Hall, 1992.
2. Modern Fracturing Enhancing Natural Gas Production, Michael J. Economides, Tony Martin, ET Publishing, 2007.

University College of Engineering Kakinada (A), JNTUK
IV Year B. Tech. Petroleum Engineering – II Semester.

Elective-III
SUBSEA ENGINEERING

Learning Objectives:

- To understand the Subsea Development operations.
- To learn the hydraulic / equipment / system design considerations.
- To learn about the Process Control and power supply consideration.
- To understand the reliability issues & design challenges involving Subsea systems.

UNIT-I

Overall View of Subsea Engineering: Introduction – Subsea production Systems – Flow Assurance & System Engineering – Subsea Structures & Equipment – Subsea Pipelines.
Subsea Field Development: Subsea Field Development Overview – Deepwater or Shallow-Water Development – Wet Tree & Drain Tree Systems – Subsea Tie-back Development – Stand-Alone Development – Artificial Lift methods and Constraints – Subsea Processing – Template, Clustered Well Systems & daisy Chain –Subsea Field development Assessment

UNIT-II

Subsea Distribution System: Introduction – Design Parameters – SDS Component Design requirements
Installation & Vessels: Introduction – Typical Installation Vessels – Vessel requirements & selection – Installation Positioning & Analysis

UNIT-III

Subsea Control: Introduction – Types of Control Systems – Topside Equipment – SCMMB – SCM – Subsea Transducers & Sensors – HIPPS – SPCS – IWOCS
Subsea Power Supply: Introduction – Electrical Power System – Hydraulic Power System

UNIT-IV

Subsea System Engineering: Introduction – Typical Flow Assurance Process - System Design & Operability
Hydraulics: Introduction – Composition & Properties of Hydrocarbon – Emulsion – Phase Behaviour – Hydrocarbon Flow – Slugging & Liquid handling – Slug Catcher Design – Pressure Surge – Line Sizing .

UNIT-V

Heat Transfer & Thermal Insulation: Introduction – Heat Transfer Fundamentals – U value – Steady State Heat Transfer – Transient Heat Transfer – Thermal management Strategy & Insulation
Hydrates: Introduction – Physics & Phase Behaviour – Hydrate Prevention – Hydrate Remediation – Hydrate Control Design Philosophies – Recovery of Thermodynamic Hydrate Inhibitors

UNIT-VI

Wax &Asphaltenes: Introduction - Wax - Wax Management – Wax remediation – Asphaltenes – Asphaltenes Control Design Philosophies

Subsea Corrosion & Scale: Introduction – Pipeline Internal Corrosion – Pipeline External Corrosion – Scales – Overview of Erosion & sand Management.

Outcomes:

- Able to do flow assurance calculations and size the piping & distribution system.
- Deliver the Equipment & System design required for a given Subsea Project Requirement.
- Anticipate reliability issues such as hydrate, wax formation, corrosion etc. during design

Text Books:

1. Subsea Engineering Handbook, Yong Bai&QiangBai, Gulf Professional Publishing, New York, 2012.
2. Offshore Drilling and Completions Training Manual by Drill – Quip, Inc.
3. Manual on Subsea Technology by IOGPT, ONGC.

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Elective-III
FUNDAMENTALS OF MULTIPHASE FLOW

Learning Objectives

a) Basic concepts of multiphase flow
b) Overview of multiphase flow models applicable for the analysis of chemical and petroleum engineering processes. These specifically refer to (a) flow through pipelines (b) flow in packed and fluidized beds.
c) Overview of various solution methods to solve multi-phase flow system models
d) Experimental techniques for the evaluation of parameters required for multiphase model solution.
e) Industrial applications of multiphase flow modeling and analysis.

UNIT- I
Basic Concepts and Definitions

UNIT- II
Gas-liquid transport in ducts

UNIT- III
Fluid-solid transport in ducts

UNIT- IV
Fluidized beds

UNIT -V
Porous Media Flows

UNIT -VI
Advanced Experimental Techniques

Outcomes:
A student proficient in multiphase flow shall be able to have expertise in the following tasks:

a) Analyze the physics of various chemical engineering problems and understand how physics eventually contribute towards multiphase models. The chemical engineering systems of specific interest include a) multiphase flow in reservoir engineering systems such as pipeline and production systems; b) multiphase flow in packed beds and c) multiphase flow in fluidized beds
b) Complexify and simplify a given multiphase model by relaxing or increasing assumptions.
c) Knowhow of solution approaches for multiphase flow models including applicable numerical techniques.
d) Working knowledge of various experimental techniques that need to be adapted to achieve desired parametric data for the validation of multiphase model.
e) Sensitivity analysis of parametric data for rigorous multiphase flow model analysis.

f) Basic knowledge of multiphase flow models in petroleum reservoir and refinery engineering processes.

Textbook:

1. Crewe C., (2006), Multiphase flow handbook, Taylor and Francis, Florida

References:

1. Brennen C., (2009). Fundamentals of Multiphase flow, Cambridge University Press

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Elective-IV
NATURAL GAS HYDRATES

Learning Objectives:
This course is designed to introduce a basic study of natural gas hydrates and its properties. The student will be imparted the knowledge of-

- Overview of NGH and classification of NGH
- Hydrate formation by using different methods
- Exhibiting hydrate formation and dehydration processes
- Different physical and chemical properties of NGH
- Deacting with hydrates using heat and pressure.

UNIT-I
Introduction: Overview of natural gas hydrates- Natural gas- Water molecule- Hydrates- Water and natural gas- Free-Water- Heavy water- Units.
Hydrate types and formers: Type I hydrates- Type II hydrates- Size of the guest molecule- n-Butane- Other hydrocarbons and non-hydrocarbon molecules- Chemical properties of potential guests- Liquid hydrate formers- Type H hydrates- Hydrate forming conditions- Pressure- Temperature- Composition- Other hydrate formers- Mixtures- Examples.

UNIT-II
Hydrate formation hand calculation methods: Gas gravity method- K-Factor method- Baillie-Wichert method- Comments on these methods- Examples.
Hydrate formation computer methods: Phase equilibrium- Van der Waals and Platteeuw- Parrish and Prausnitz-Ng and Robinson methods- Calculations- Commercial software packages- Accuracy of these programs- Dehydration- Examples.

UNIT-III
Inhibiting hydrate formation with chemicals: Freezing point depression- Hammerschmidt equation- Nielsen-Bucklin equation- New method- Brine solutions- Comment on the simple methods- Advanced calculation methods- Inhibitor vaporization- Comment on injection rates- Kinetic inhibitors- Examples.
Dehydration of natural gas: Water content specification-Glycol dehydration- Molecular sieves- Refrigeration- Examples.

UNIT-IV
Combating hydrates using heat and pressure: Use of heat- Heat loss from a buried pipeline- Line heater deign- Two-Phase heater transfer- Depressurization- Melting a plug with heat- Examples.

UNIT-V
Physical properties of hydrates: Molar mass - Density- Enthalpy of fusion- Heat capacity- Thermal conductivity- Mechanical properties- Volume of gas in hydrate- Ice versus hydrate- Examples.

Phase diagrams: Phase rule- Comments about phases- Single component systems- Binary systems- Phase behavior below 0°C- Multicomponent systems- Examples.

UNIT-VI

Water content of natural gas: Equilibrium with liquid water- Equilibrium with solids- Examples.

Outcomes:

After successful completion of the course the students will be able to-

- Have good knowledge in dealing with NGH
- Model different hydrate formation using both hand calculations and computer methods
- Understand different properties of NGH
- Design line heaters foe effective transportation
- Have knowledge of different equilibriums of liquid water and solids with natural gas
- Understand the challenges of NGH

Text Books:

1. Natural Gas Hydrates: A Guide for Engineers, John J. Carroll, Gulf Professional Publishers, 2003.
2. Clathrate Hydrates of Natural Gases, E. Dendy Sloan, Jr., C. Koh, 3rdEdition, CRC Press, 2007.

Reference Book:

1. Natural Gas Hydrates in Flow Assurance, E. Dendy Sloan, C. Koh, A. K. Sum, A. L. Ballard, J. Creek, M. Eaton, N. McMullen, T. Palermo, G. Shoup and L. Talley, Elsevier, 2010.

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Elective-IV
ADAVANCED NATURAL GAS ENGINEERING

Learning Objectives:
The student will learn the following aspects:

- Basics on Natural Gas resources and properties. Natural Gas Exploration, drilling & well completion techniques.
- Gas & liquid separation, gas dehydration & sweetening, gas compression & transportation.
- Hydrate prediction and control in Natural Gas pipelines & systems.
- LNG Processes, Carriers and terminals.
- Basics on Gas to Liquid strategy, technology options and GTL economics.

UNIT-I:
Natural Gas Basics: Natural gas origins-Accumulations- Natural gas resources-Natural gas composition and phase behavior- Review of natural gas properties.

UNIT-II:
Unique issues in natural gas exploration, Drilling and Well completion: Exploration-Drilling-Well completion.
Natural Gas Production: Darcy and non-Darcy flow in porous media -Gas well inflow under Darcy flow and non-Darcy flow -Horizontal gas well inflow- Hydraulic fracturing- Well deliverability.
Liquid loading on gas wells: Turners methods – Guo's methods – Comparison of methods.

UNIT-III:
Natural gas processing: Natural gas and liquid separation- Dehydration-Sweetening.
Natural gas transportation- Pipelines and compressed natural gas: Pipelines- Marine CNG Transportation.

UNIT-IV:
Hydrate control: Hydrate forming conditions – Preventing hydrate formation.
Pipeline cleaning: Pigging system – Selection of pigs – Major applications – Pigging procedure.
Liquefied Natural gas: LNG liquefaction processes- Thermodynamic analyses- C_3 MR process- Single mixed refrigerant loop process- Mixed fluid cascade process- Liqulifin^{TM} process DMR process- LNG carriers- LNG terminals.

UNIT-V:
Gas-To-Liquids (GTL): Why GTL?- GTL processes GTL based on direct conversion of natural gas- GTL based on indirect conversion of natural gas- GTL economics.
Underground Natural gas storage: Types of underground storage- Storage measures -Losses in gas storage-Injectivity in gas storage well.

UNIT-VI:

Natural gas supply, alternative energy sources and the environment: Advantages of fossil fuels - Energy interchange ability Vs inflexibility-Regional gas supply potential - Alternatives to natural gas fixed electricity- Economics of electricity generation from different energy sources- Environmental impact of fossil fuels and renewable energy sources.

Outcomes:

The student shall be able to independently carryout the following tasks:

- Estimation of Natural gas properties and application of suitable techniques for natural gas exploration and production.
- Estimation of liquid loads on gas wells using various techniques.
- Design gas liquid separation, dehydration & sweetening systems.
- Design Natural gas transportation systems, pipelines and compression systems
- Selection & design of Liquified Natural Gas processes & loading /transportation systems.
- GTL process technology selection and GTL economics.
- Natural gas underground storage design and operational aspects.
- Natural supply, pricing & economic evaluation Vs alternate energy sources.

Text Books:

1. Advanced Natural Gas Engineering, Xiuli Wang and Michael Economides, Gulf Publishing Company, 2009.
2. Natural Gas Engineering Handbook, BojunGuo and Ali Ghalambor, Gulf publishing company, 2005.

Reference Books:

1. Handbook of Natural Gas Engineering, D.L.Katz, McGraw-Hill, 1959.
2. Natural Gas Production Engineering, Chi U. Ikoku, Krieger Publishing Company, 1992.
3. Troubleshooting Natural Gas Processing: Well head to Transmission, Norman P. Lieberman, Pennwell Publishing Company, 1997.
4. Practical Natural Gas Engineering, R.V.Smith, 2nd Edition, PennWell, 1990.

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Elective-IV
PETROLEUM BIOTECHNOLOGY

Learning Objectives:

- To gain an overview of applications of biotechnology in petroleum industry and the use of petroleum biotechnology
- To learn about the various types of microbial species that survive in deep surface oil reservoirs
- To evaluate the prospect for biological upgradation of heavy oils and asphaltenes
- To understand the biotechnological approach for enhanced oil recovery
- To study the conversion of sulfur derivatives to the hydrogen sulfide using nitrate control microbes
- To gain knowledge of bioremediation of marine spills
- To learn the basic compounds of bio corrosion and the use of molecular biology tools in microbial corrosion

UNIT-I
Overview of application of biotechnology in petroleum industry - Use of petroleum biotechnology throughout the value chain of an oil company.

UNIT-II
The microbial diversity of deep surface oil reservoirs.

UNIT-III
Prospects for biological upgrading of heavy oils and asphaltenes.

UNIT-IV
Biotechnological approach for development of microbial enhanced oil recovery.

UNIT-V
Using nitrate control microbially produced hydrogen sulfide in oil field waters.

UNIT-VI
Bioremediation of marine spills.
Bio-corrosion and molecular biology tools in microbial corrosion.

Outcomes:

On completion of the course, student would be able to:

- Understand the applications of biotechnology in petroleum industry
- Understand the microbial diversity of deep surface oil reservoirs
- Gain the knowledge of how to upgrade the heavy oils and asphaltenes
- Learn the techniques for enhanced oil recovery using suitable microorganisms

- Know the sweetening of crude using nitrate control microbes
- Understand the bioremediation of marine spills
- Understand the concepts of bio corrosion and the use of molecular biology tools in microbial conversion

Text Book:

1. Petroleum Biotechnology: Developments and Perspectives, Rafael Vazquez – Duhalt, Rodolfo Quintero Ranuruz, Elsevier, 2004.

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PROJECT WORK

The project work may consist of any one of the following:

a) The project work should consist of a comprehensive design project of any one of the petroleum upstream processes concerned with reservoir, drilling, production, surface production operations, stimulation, enhanced oil recovery in the form of a report.

b) Modeling & Simulation of any petroleum upstream unit concerned with reservoir, drilling, production, surface production operations, stimulation, enhanced oil recovery.

c) Any experimental work with physical interpretations.