UNIT 1: BODY LANGUAGE, GROOMING AND LEADERSHIP FOR ENGINEERS

A Lecture By: Dr. Vagisha Mishra

What do we mean by “Personality”?

- The word personality itself stems from the Latin word *persona*, which refers to a theatrical mask worn by performers in order to either project different roles or disguise their identities.

- Personality is defined as the characteristic sets of behaviors, cognitions, and emotional patterns that evolve from biological and environmental factors.

- Personality is the characteristic patterns of thoughts, feelings, and behaviors that make a person unique. It is believed that personality arises from within the individual and remains fairly consistent throughout life.

What Kind of Personality Do Employers Search For?

- Employers are searching for more than just a long a resume. It's not only about what an employee can do, but also about how he does it, and how he carries himself while doing it.

1. Confidence
2. Professionalism
3. Openness to New Experiences
4. Intellectual Curiosity
5. Willingness
6. Self-monitoring

Body Language

- We use body language whenever we communicate face to face. It's a nonverbal language that emphasizes or alters the meaning of the direct language we use. We speak to others through our body movements, posture, eye contact, hand gestures, tone and volume of voice, facial expressions, and micro-expressions that hold meaning for us as well as for our audience. Understanding body language can help improve communication.
- Body language is not only powerful, it's usually reliable for revealing your true feelings, too. However, body language isn't completely reliable if the person expressing it knows how to manipulate it well.

Why is Body Language Important for Engineers?

- Communication is critical in any engineering work. It is that component which allows for the effective implementation of tasks and smooth flow of work operations. But more often than not, the term is limited to verbal and written means, forgetting that there is a third category which is equally important: **nonverbal communication**.
- Nonverbal communication is one which expresses messages through facial expressions, gestures, and body language. It also includes how we modulate the tone and pitch of our voice and how we place ourselves relative to others.
- For one, nonverbal communication can give clues and additional information and meaning over and above verbal communication. It helps people to reinforce or modify what is said in words, convey information about our emotional state, define or reinforce our relationship with others, provide feedback to the other person, and regulate the flow of communication.
- Body language, being the best form of nonverbal communication, is manifested through different expressions as listed below. Engineers should be careful in making these expressions because they can affect impressions.

Posture: It Speaks Before You Do!

- When in meetings or casual conversations, engineers should always appear confident. One way to do this is to move around with a good posture. “In business, you’ve got to remember that when you walk into a boardroom, people have already made a decision about you by the time you sit down,” Eliot Hoppe, an author and expert on body language, told CNBC. “Stand upright, have a brisk walk, you want to convey that you want to be there and are confident. If you slump your shoulders–what message will that give?” he said.
- A brisk walk is a relative term, since “brisk” for some, is either slow or quite speedy for others, depending on levels of fitness. One measure to quantify brisk walking is “steps per minute,” and 100 steps per minute is considered moderate intensity or brisk walking.
- Your posture and other body language makes you feel more powerful and boosts confidence. A study from Ohio State University found that those who sat up straight had more confidence in their own abilities and believed more strongly in positive statements they had written about themselves.
- When your body is out of balance, that is to say, when you are hunched over that keyboard or your head is pushed forward when you are standing or walking, you can’t perform to your true potential. This is especially true if you end up with neck or back aches later on in your day because you are slouching. When you feel good, you look good, and you can perform like a champion!
- This should be fairly obvious to everyone. Have you ever seen a CEO slumped over their computer? Think of the movie Shawshank Redemption, when escaped prisoner Andy Dufresne sits in front of the bank executive to cash out his account. His posture screams confidence and authority in that scene. Imagine if he had been a quiet mouse, staring at his feet, with slumped over posture. Your posture can make a huge difference in how you are perceived.
- Try to be mindful of the way you’re sitting, standing and sleeping, and avoid any unnatural positions. Ask friends and family to remind you to stop slouching, too!

Handshake and Power Play

- There is also politics in handshakes, Hoppe implied by saying that there is “power play” that can take place.
- If the handshake is firm, if the other person tries to turn the handshake so that his or her hand is on top, or if he or she uses the second hand to shake your hand and pat your arm, there is a meaning: the one you are shaking hands with is trying to be dominant or aggressive towards you. If you subconsciously do this, it could also leave the same impression to others.

Touch

- When you see someone touch their face you instantly distrust them or feel uneasy about them. This is why you should never touch your face when talking with others: it conveys deceit, insincerity, and mistrust.
- It is common for people to use their hands to touch their faces when they feel insecure. The gesture might be the result of an uncomfortable situation, which could be social or professional.
- Touching nails, or playing with hair.

Tonality

- There are two things that you should be mindful about the tone of your voice. “When you’re making a statement, command or directive, your voice goes down at the end of the sentence. So if you’re trying to convince someone of something, make sure it goes down.”
- Meanwhile, a person who is trying to deceive someone will tend to raise the voice at the end of a sentence – trying to convince either himself or you.
- Examples: Arguments and conflict in team management, taking accountability of the mistake

Power Dressing

- Think twice about wearing anything red and yellow as they are considered to be colors of power. They can either be interpreted as confidence or arrogance by your boss.
- Why Formal Dressing is addressed and highlighted?

If you want to make the right impression (and land the job), you've got to dress the part.

- Let's say you're going to an interview at a company where no one ever wears a suit—not even the CEO. Should you still dress formally for the occasion, or will you look out of place?
- And if you do decide to go for a more casual look, how can you make sure that you still appear professional and respectful?

Feeling Vulnerable

- When we feel vulnerable we protect our neck area. When another person feels vulnerable too they will try to protect themselves–holding a book or papers over their chest or touching their neck–these are all self-assurance techniques.
- In this aspect, it is also important to note how your items could affect impressions: if you have a pen or glasses or pen with chewed ends, it could say something about your thought process and confidence.

Standing position

- There is research indicating 75% of the people being more comfortable when they talk to a person with the right eye directly facing his or her colleague’s right eye. For this, he recommends that you take a small step to your left for a higher chance of the other end to experience comfort while having a conversation with you.

Arms Crossed Across The Chest

- Your arms and legs are perhaps one of the first types of nonverbal communication that people notice when they see you. You can use them for positive body language or negative body language.
- Sitting or standing with your arms crossed across your chest is nearly always seen as defensive body language. Universally, people view a person that has crossed arms as insecure, annoyed, or closed off. When you do it, you're closed off and disengaged. You may appear angry or stubborn.
- If you see someone with their arms and legs crossed for a long period of time, remember that it could indicate that the temperature where you are is too cold. It could also mean they're tired or simply supporting their shoulders in an armless chair.

Smile

- Smiles can mean different things, depending on the exact facial expression. There are happy smiles, shy smiles, warm smiles, and ironic smiles. The Duchenne smile consists of pulling up the corners of your mouth while squeezing your eyes. It's considered a genuine smile, as opposed to a fake smile where you just expose your teeth. Have you ever heard of the term, “smiling eyes?” Some people are really good at sending a smile through direct eye contact. When you display an authentic Duchenne smile, you let people know you're approachable and friendly.

. Tapping Your Fingers

- When you tap your fingers, you appear impatient and possibly nervous about waiting. If you're a finger tapper, be aware that it's one of those nonverbal signals that can grate on others' nerves.

Tilting Your Head to One Side

- When you tilt your head to the side, it usually means you're listening intently and deeply interested in finding out the information you're being told. It can also mean you're concentrating very hard.

Steepling Your Fingers

- Holding your fingertips together and your palms apart let people know you have authority and control. Bosses and politicians use this gesture often to show they're in charge.

Crossing Your Legs

- The way you cross your legs can tell others a lot about you and how you're feeling at any given moment. If you cross them at the ankle, it may show that you're trying to hide something. If you cross them at the knee but point your knees away from the other person, you show you're uncomfortable with them. In most cases, the best option is to plant your feet firmly on the floor.

Putting Your Head In Your Hands

- When you put your head in your hands, it might mean that you're bored, as if you're so weary of life that you just can't hold your head up anymore. Or, it can mean that you're upset or so ashamed you don't want to show your face.

Eye Contact

- You need to make eye contact with the person you're talking to if you want them to feel comfortable with the conversation and accept what you have to say. Scientists suggest that most people are comfortable with eye contact of about 3.2 seconds at a time if you're a stranger. When you become a friend, they usually don't mind having eye contact with you for longer at a time.

Looking Down

- Looking at the floor or ground makes you appear weak and unconfident. Unless there's something you need to discuss down there, you need to keep your eyes on the level of the other person's face. When you break eye contact, as you should every few seconds, try looking to the side.

Microexpressions

- Microexpressions are extremely brief facial expressions that happen in about 1/25th of a second. They happen when you're trying to hold back your emotions. When you see someone showing a microexpression, it usually means that they're trying to conceal something from you. However, if you learn to spot them, you can gain an advantage in any type of interaction.

Lower your vocal pitch

- In the workplace, the quality of your voice can be a deciding factor in how you are perceived. Speakers with higher-pitched voices are judged to be less empathic, less powerful and more nervous than speakers with lower pitched voices. One easy technique I learned from a speech therapist was to put your lips together and say “Um hum, um hum, um hum.” Doing so relaxes your voice into its optimal pitch. This is especially helpful before you get on an important phone call – where the sound of your voice is so critical.

Try Power Priming

- To display confidence and be perceived as upbeat and positive, think of a past success that fills you with pride and confidence. Then recall the feeling of power and certainty – and remember or imagine how you looked and sounded. Recalling that genuine emotion will help you embody it as you enter the meeting room or walk up to the podium.

Talk with your hands

- Brain imaging has shown that a region called Broca's area, which is important for speech production, is active not only when we're talking, but also when we wave our hands. Since gesture is integrally linked to speech, gesturing as you talk can actually power up your thinking.
- Whenever I encourage people to incorporate gestures into their deliveries, I find that their verbal content improves, their speech is less hesitant, and their use of fillers ("ums" and "uhs") decreases. Experiment with this and you'll find that the physical act of gesturing helps you form clearer thoughts and speak in tighter sentences with more declarative language.

Reduce nervous gestures

- When we're nervous or stressed, we all pacify with some form of self-touching, nonverbal behavior: We rub our hands together, bounce our feet, drum our fingers on the desk, play with our jewelry, twirl our hair, fidget -- and when we do any of these things, we immediately rob our statements of credibility.
- If you catch yourself indulging in any of these behaviors, take a deep breath and steady yourself by placing your feet firmly on the floor and your hands palm down in your lap, on the desk or on the conference table. Stillness sends a message that you're calm and confident.

WHAT IS LEADERSHIP?

- Here's the thing about leadership that a lot of people either don't understand or refuse to believe: Everyone can be a leader. There is no single answer to "What is leadership?" because it isn't something you're either born with or without, but a powerful skill that can be developed over time.

- Great leaders don't follow a single path or personality type. In fact, you've probably taken on leadership roles in your life that you didn't realize at the time. So what makes a good leader, really? And how can you sharpen those skills and put them to work for you in your career and your life?

- Leadership is the ability to inspire a team to achieve a certain goal. It's usually discussed in the context of business, but leadership is also how you, as an individual, choose to lead your life. The definition of leadership is to influence, inspire and help others become their best selves, building their skills and achieving goals along the way. You don't have to be a CEO, manager or even a team lead to be a leader. Leadership is a set of skills – and a certain psychology – that anyone can master.

- Leadership is not a zero-sum equation. When one person harnesses their powers to lead, it strengthens the leadership opportunities of others, rather than diminishing them. That's because the ultimate definition of leadership is empowering others to become effective leaders as well. That's why many iconic leaders have incredible mentors they cite for their success. As one person begins to embrace their role as a leader, they inevitably connect with others who have already mastered the art of leadership.

THE IMPORTANCE OF LEADERSHIP

- In short, the importance of leadership lies in the ability to get things done. Leadership allows you to communicate a clear vision and then unite your team around that vision.

- Companies with great leaders are creative, innovative and agile. They also have positive company cultures with a sense of purpose and passion. Ultimately, effective leadership improves your company's bottom line, resulting in less turnover and a mindset of continuous improvement.

- But the importance of leadership also shows in other aspects of life. It's a set of skills you can take with you into relationships and on your path to personal improvement. And you can start learning them today.

UNIT 2: STRESS MANAGEMENT

A Lecture By:
Dr. Vagisha Mishra

STRESS AND ITS MANAGEMENT

- Our increasingly busy lives cause our minds a lot of stress. Stress is mental tension caused by demanding, taxing or burdensome circumstances. Stress doesn't just affect our mental state and mood; it affects our physical health as well.
- When we are very stressed, a hormone called cortisol is released into our bloodstream, suppressing the functioning of our immune, digestive and reproductive systems. That is why it is so important to practice stress management in order to keep our minds and bodies healthy.
- Stress management consists of making changes to your life if you are in a constant stressful situation, preventing stress by practicing self-care and relaxation and managing your response to stressful situations when they do occur.

STRESS AND ITS MANAGEMENT

- Before we move on to stress management techniques, it's important to note that not all stress is bad. Stress is actually a survival response when our body thinks that it is in danger.
- That is why our sympathetic nervous system kicks in and makes our heart rate increase and gives us a burst of the energy hormone, adrenaline, so that we can deal with whatever situation is being thrown at us. This is also called our flight or fight response.
- The problem is when we deal with constant stress and worry, or when we don't know how to properly manage a stressful situation. That's why stress management is tremendously important for our health, quality of life and relationships.

BENEFITS OF STRESS MANAGEMENT

It has already been said that stress causes mental and physical strain, tension and even illness. It can affect all areas of our lives. Some examples of health problems stress can cause include:

STRESS

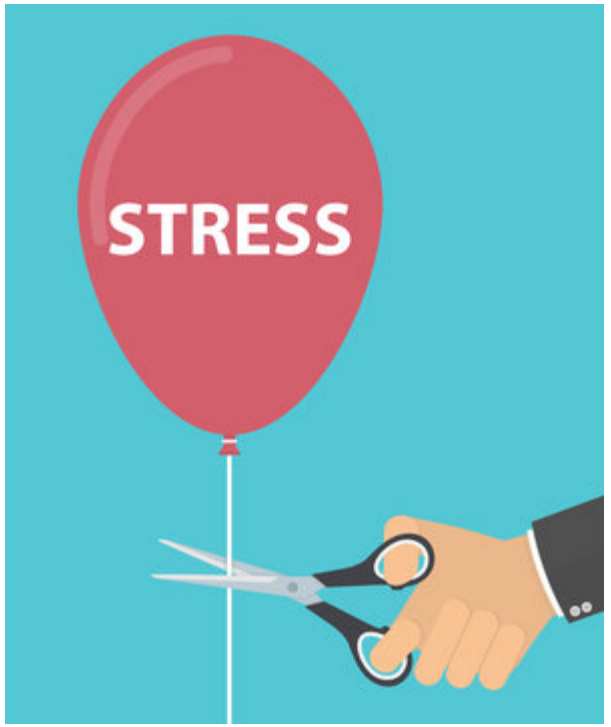
The Nation's #1 Killer

Medically Proven Stress Contributes to:

* Heart Disease
* Strokes
* High Blood Pressure
* Colitis
* Irritability
* Rheumatism
* Depression
* Migraines
* Diabetes
* Hardening-of the Arteries
* Insomnia
* Fatigue
* Sex Problems
* Skin Diseases
* Allergies
* Overeating
* Asthma
* Kidney Disorders
* Ulcers
* Breathing Problems
* Increased Smoking

CHANGE THE STRESSFUL SITUATION

- The first thing that you need to consider when encountering a short- or long-term stressful situation is, 'Can I change the situation so that it does not cause me stress anymore?' If it's a person in your life that is constantly negative and critical of you, can you distance yourself from that person? If it is a job that you are doing, can you start making moves to look for a new job or obtain a different position?
- There is a quote by a famous spiritual leader, Eckhart Tolle, that says, 'When you complain, you make yourself the victim. Leave the situation, change the situation or accept it. All else is madness.'



QUESTIONS YOU NEED TO ASK YOURSELF!

1. Are you missing out on deadlines?
2. Have you witnessed a significant drop in productivity?
3. Are you least motivated to work?
4. Have you seen a rise in the workplace stress levels?

Leadership helps to grasp the effects of stress on the employees' daily lives. Prolonged stress harms the mental and physical health of employees. Moreover, if not addressed in time it can lead to chronic stress that can be detrimental in the long run.

WHAT IS STRESS MANAGEMENT?

- Stress management is the broad spectrum of techniques that help a person to control their stress levels. The purpose of stress management is to improve the everyday functioning of an employee and increase job satisfaction.
- It is common to feel stressed. However, if this stress persists on a daily basis, it can impair our ability to perform. Chronic stress can ultimately lead to serious health complications.
- However, one can tackle the issue if one understands the signs of stress and work on resolving it.

WHAT IS STRESS MANAGEMENT?

With some handy stress management tricks, an employee can:

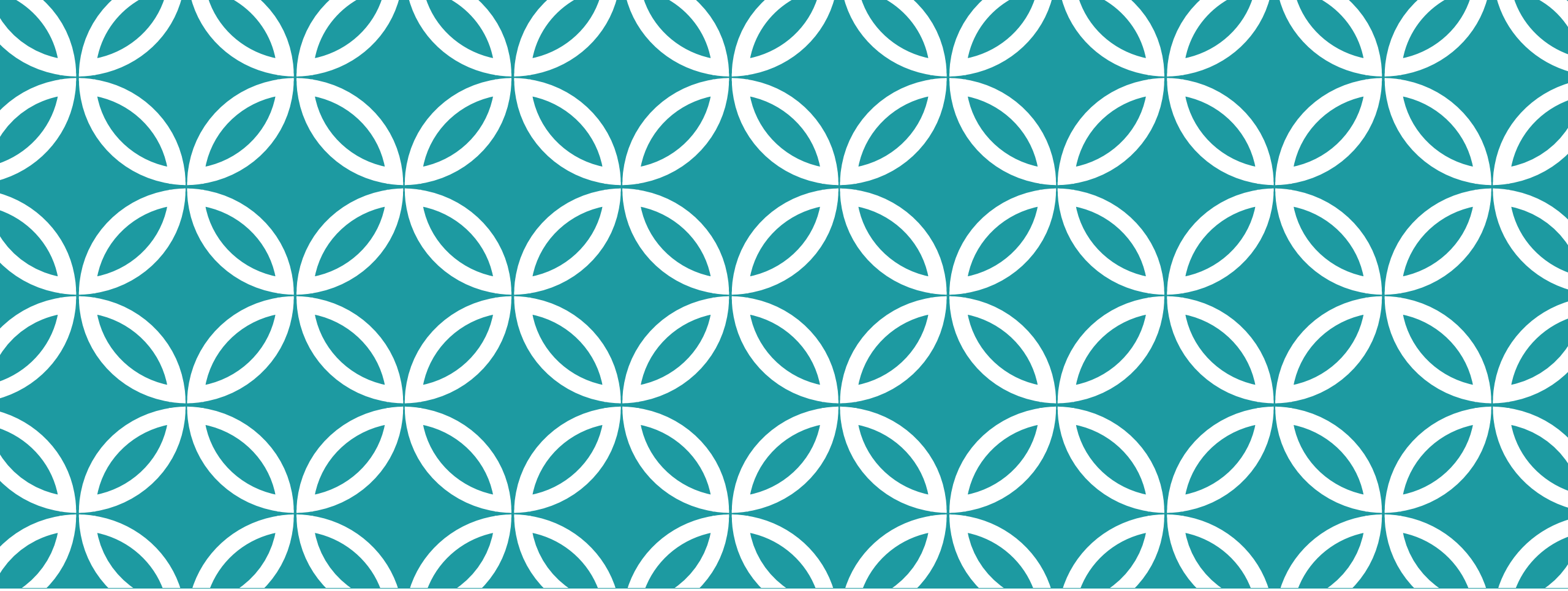
Managers must understand the severity of what stress can lead to and how it impacts the organization. You need to acknowledge it and recognize stress among employees to further stop it from escalating.

.REASONS BEHIND STRESS AT WORKPLACE

- The reasons behind high levels of stress in the workplace can vary. But managers need to selectively emphasize on few of the factors that are troublesome. Below is a list of some common reasons-

.MANAGER’S ROLE IN STRESS MANAGEMENT

- Survey to find out the reasons for employees' stress
- Create an action plan of solving the problem
- Communicate the plan to the employee. Take their inputs into consideration. It will help them feel like they have power over their stressors.
- Train executives and senior leaders on how to handle burnout and stress among their people



TIPS FOR ENGINEERS TO REDUCE WORK STRESS

1. IDENTIFY THE CAUSE OF THE STRESS

- First, identify the cause of the stress.
- Once the cause of the stress is identified, start tackling ways in which you might reduce that stress.
- If there are concerns about deadlines, create a list of what you need to accomplish in a step-by-step format.
- Review your time management and identify detractors that are preventing timely project completion.

2. LEARN TO SAY “NO”

- Sometimes minimizing stress and preventing overload is as fundamental as saying no.
- If you feel like you are being approached with deadlines that are impossible to meet, provide a more reasonable solution.
- Outline what demands can be made by the deadline and provide a time when the rest of the work can be completed.
- It is important to emphasize safety; a rushed engineer may be in danger of making a critical error.

3. HAVE AN END OF THE DAY HABIT

- Set a routine and have an end of the day habit.
- Perhaps this means creating a list for what you will do tomorrow by lining up tomorrow's tasks.
- File paperwork, arrange your office, send end of the day review emails to the team.
- Set yourself up for a successful succeeding day at the end of the day, so that you don't stress in the evening that you're going to have to work double time in the morning.

4. PRACTICE BREATHING TECHNIQUES AND MEDITATION

- You can practice breathing and meditation techniques anywhere.
- If you feel work stress getting to you in the middle of the day, breathe in and count to ten seconds and breathe out for ten seconds. This simple exercise often helps to immediately reduce stress and anxiety.
- On the commute to and from work, visualize yourself as being successful. In the morning, visualize yourself having a successful day.
- And on the way home, meditate and visualize leaving the stress behind so when you walk in your door, you are able to just relax.

5. EXERCISE

- Exercise helps tackle stress. If midday stress is starting to creep in, see if you can take a walk around or outside the office to breathe and meditate.
- Make it an end of the day routine to stop by the gym a couple of nights a week on the way home; consider taking the stairs rather than the escalator or find opportunities to stretch and have a relaxing walk.

6. DEVELOP GOOD TECHNOLOGY HABITS

- There will be times when deadlines have you working after hours. But set a time limit to your day, especially when responding to emails.
- Many employees assume that answering emails throughout the evening shows how dedicated they are to the job. However, this may have a deleterious effect. In doing so, you remove the boundaries of acceptable times for people to contact you and people may think you are available at any hour of the day.
- Prioritize your time, and that includes time needed for yourself.

7. CONFINE YOUR WORK TO A PARTICULAR LOCATION

- If possible, confine your work to a particular location. Make this the location of your productivity.
- Reserve spaces for no work, especially the bedroom or family living quarters. If you are required to work from home occasionally, set a spot in a corner or create a small office. When you leave the office, leave the work be for a while.

8. PRIORITIZE SLEEP

- A sleepy engineer is bound to be a subpar engineer. Prioritize your time for restful sleep. Set an evening routine, avoid responding to work emails in bed and create a space in your room that encourages restfulness. Proper sleep helps reduce stress and has a wide variety of health benefits.
- While work stress may be inevitable, especially in the engineering profession, there are steps you can take to prevent bringing too much work stress home. The role of an engineer is critical to the success and safety of the world that surrounds us; a healthy engineer is a benefit to everyone.

SOURCES OF STRESS

The Environment – the environment can bombard you with intense and competing demands to adjust. Examples of environmental stressors include weather, noise, crowding, pollution, traffic, unsafe and substandard housing, and crime.

Social Stressors – we can experience multiple stressors arising from the demands of the different social roles we occupy, such as parent, spouse, caregiver, and employee. Some examples of social stressors include deadlines, financial problems, job interviews, presentations, disagreements, demands for your time and attention, loss of a loved one, divorce, and co-parenting.

Physiological – Situations and circumstances affecting our body can be experienced as physiological stressors. Examples of physiological stressors include rapid growth of adolescence, menopause, illness, aging, giving birth, accidents, lack of exercise, poor nutrition, and sleep disturbances.

Thoughts – Your brain interprets and perceives situations as stressful, difficult, painful, or pleasant. Some situations in life are stress provoking, but it is our thoughts that determine whether they are a problem for us.

TYPES OF STRESSORS

Situations that are considered stress provoking are known as stressors. Stress is not always a bad thing. Stress is simply the body's response to changes that create taxing demands. Many professionals suggest that there is a difference between what we perceive as positive stress, and distress, which refers to negative stress. In daily life, we often use the term "stress" to describe negative situations. This leads many people to believe that all stress is bad for you, which is not true.

Positive stress has the following characteristics:

• Motivates, focuses energy

• Is short-term

• Is perceived as within our coping abilities

• Feels exciting

• Improves performance

In contrast, negative stress has the following characteristics:

• Causes anxiety or concern

• Can be short or long-term

• Is perceived as outside of our coping abilities

• Feels unpleasant

• Decreases performance

• Can lead to mental and physical problems

INTERNAL SOURCES OF STRESS AND ANXIETY

- Stressors are not always limited to situations where some external situation is creating a problem. Internal events such as feelings, thoughts, and habitual behaviors can also cause negative stress.
- Common internal sources of distress include:

• Fears (e.g., fears of flying, heights, public speaking, chatting with strangers at party)

• Repetitive thought patterns

• Worrying about future events (e.g., waiting for medical test results or job restructuring)

• Unrealistic or perfectionist expectations

- Habitual behavior patterns that can lead to stress include:

• Over scheduling

• Failing to be assertive

• Failing to set and maintain healthy boundaries

• Procrastination and/or failing to plan ahead

COGNITIVE ASPECTS OF STRESS AND ANXIETY

Anxiety is a feeling that we commonly experience when faced with stressful life events. Anxiety can be one of the most distressing emotions that people feel. It is sometimes called “fear or nervousness”. Common reactions to anxiety include:

Physical Symptoms:

- Sweaty palms
- Muscle tension
- Racing heart
- Flushed cheeks
- Light headedness

COGNITIVE ASPECTS OF STRESS AND ANXIETY

Behaviors:

• Avoiding situations where experiencing anxiety might occur

• Leaving situations when feelings of anxiety begins to occur

• Trying to do things perfectly or trying to control events to prevent danger

Moods:

• Nervous

• Irritable

• Anxious

• Panicky

Thoughts:

• Overestimation of danger

• Underestimation of your ability to cope

• Underestimation of help available

• Worries and catastrophic thoughts

. SIGNS AND SYMPTOMS OF STRESS OVERLOAD

- Three common ways that people respond when they are overwhelmed by stress are:

1. An angry or agitated stress response. You may feel heated, keyed-up, overly emotional, and unable to sit still.

2. A withdrawn or depressed stress response. You shut down, space out, and show very little energy or emotion.

3. Both a tens and frozen stress response. You "freeze" under pressure and feel like you can't do anything. You look paralyzed, but under the surface you may feel extremely agitated.

COGNITIVE SYMPTOMS OF STRESS

- Memory problems
- Inability or difficulty concentrating
- Poor judgment
- Seeing only the negative
- Anxious, racing, or ruminating thoughts
- Constant worrying

EMOTIONAL SYMPTOMS OF STRESS

- Moodiness
- Irritability or short-tempered
- Agitation, inability to relax
- Feeling overwhelmed
- Sense of loneliness or isolation
- Depression or general unhappiness

BEHAVIORAL SYMPTOMS OF STRESS

- Eating more or less
- Sleeping too much or too little
- Isolating yourself from others
- Procrastinating or neglecting responsibilities
- Using alcohol, cigarettes, or drugs to relax
- Nervous habits (nail biting, pacing)

1. Start off your day with breakfast.
2. Occasionally change your routine by meeting a friend or co-worker for breakfast. Allow time to relax and enjoy it.
3. Find some time during the day to meditate or listen to a relaxation CD.
4. Instead of drinking coffee all day, switch to fruit juice.
5. Organize your work - set priorities.
6. Don't try to be perfect. Don't feel like you must do everything.
7. Avoid trying to do two, three, or more things at a time.
8. Develop a support network.
9. If possible, reduce the noise level in your environment.
10. Always take a lunch break (preferably not at your desk).
11. Optimize your health with good nutrition, sleep and rest.
12. Get regular exercise.
13. Celebrate birthdays and other holidays. Turn more events into special occasions.
14. Look at unavoidable stress as an avenue for growth and change.
15. Avoid people who are "stress carriers."
16. Avoid people who are "negaholics."
17. Don't watch the 11 p.m. news.
18. Give yourself praise and positive strokes.
19. Develop a variety of resources for gratification in your life, whether it's family, friends, hobbies, interests, special weekends or vacations.
20. Treat yourself to "new and good things."
21. Be assertive. Learn to express your needs and differences, to make requests, and to say "no" constructively.
22. Seek out the emotional resources available to you such as co-workers, partner, friends and family.
23. Don't be afraid to ask questions or to ask for help.
24. Allow extra time to get to appointments.
25. Take deep breaths when you feel stressed.
26. Try to find something funny in a difficult situation.
27. Take an occasional "mental health day."
28. Adopt a pet.
29. Take a mindful walk.
30. Understand that we do not all see or do things in the same way.
31. Practice mindfulness - learn to live in the moment.
32. Become a less aggressive driver.
33. Show kindness and consideration. Open a door for someone, pick up litter, etc.
34. When stressed, ask yourself "Is this really important?" and "Will this really matter a year from now?"
35. Resist the urge to judge or criticize.
36. Become a better listener.
37. Be flexible with change - things don't always go as we planned.
38. If spiritual, pray; speak to God, a higher power, or your inner guide.

38 STRESS BUSTERS

Show that the following matrices are not similar to diagonal matrices.

(i) $\begin{bmatrix} 2 & 3 & 4 \\ 0 & 2 & -1 \\ 0 & 0 & 1 \end{bmatrix}$ (ii) $\begin{bmatrix} 2 & -1 & 1 \\ 2 & 2 & -1 \\ 1 & 2 & -1 \end{bmatrix}$

(iii) $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$ (iv) $\begin{bmatrix} 3 & 10 & 5 \\ -2 & -3 & -4 \\ 3 & 5 & 7 \end{bmatrix}$

Show that the following matrices are similar to diagonal matrices. Find the diagonal and modal matrix in each case.

(i) $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ (ii) $\begin{bmatrix} -17 & 18 & -6 \\ -18 & 19 & -6 \\ -9 & 9 & 2 \end{bmatrix}$

(iii) $\begin{bmatrix} 1 & -6 & -4 \\ 0 & 4 & 2 \\ 0 & -6 & -3 \end{bmatrix}$ (iv) $\begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$

Ans. :

(i) $D = \begin{bmatrix} 5 & 0 & 0 \\ 0 & -3 & 0 \\ 0 & 0 & -3 \end{bmatrix}, P = \begin{bmatrix} 1 & -2 & 3 \\ 2 & 1 & 0 \\ -1 & 0 & 1 \end{bmatrix}$

(ii) $D = \begin{bmatrix} -2 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}, P = \begin{bmatrix} 2 & 1 & -1 \\ 2 & 1 & 0 \\ 1 & 0 & 3 \end{bmatrix}$

(iii) $D = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$,

$P = \begin{bmatrix} 1 & 2 & 2 \\ -2 & -2 & 1 \\ 3 & 3 & -2 \end{bmatrix}$

(iv) $D = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}, P = \begin{bmatrix} 4 & 3 & 2 \\ 3 & 2 & 1 \\ 2 & 1 & 1 \end{bmatrix}$

3. Determine diagonal matrices orthogonally similar to the following real symmetric matrices. Also, find modal matrix in each case.

(i) $\begin{bmatrix} 7 & 4 & -4 \\ 4 & -8 & -1 \\ -4 & -1 & 8 \end{bmatrix}$

(ii) $\begin{bmatrix} 7 & 0 & -2 \\ 0 & 5 & -2 \\ -2 & -2 & 6 \end{bmatrix}$

Ans. : (i) $D = \begin{bmatrix} 9 & 0 & 0 \\ 0 & -9 & 0 \\ 0 & 0 & -9 \end{bmatrix}$,

$P = \begin{bmatrix} \frac{4}{\sqrt{18}} & 0 & \frac{1}{3} \\ \frac{1}{\sqrt{18}} & \frac{1}{\sqrt{2}} & -\frac{2}{3} \\ -\frac{1}{\sqrt{18}} & \frac{1}{\sqrt{2}} & \frac{2}{3} \end{bmatrix}$

(ii) $D = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 6 & 0 \\ 0 & 0 & 9 \end{bmatrix}$,

$P = \begin{bmatrix} \frac{1}{3} & \frac{2}{3} & \frac{2}{3} \\ \frac{2}{3} & -\frac{2}{3} & \frac{1}{3} \\ \frac{2}{3} & \frac{1}{3} & -\frac{2}{3} \end{bmatrix}$

4. Find the symmetric matrix A having eigen values $\lambda_1 = 0$, $\lambda_2 = 3$ and $\lambda_3 = 15$ with the corresponding eigen vectors $X_1 = [1, 2, 2]^T$, $X_2 = [-2, -1, 2]^T$ and X_3.

Ans. : $\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$

Solve the following differential equations:

1. $y^2\frac{dy}{dx}+x^2=0$.

[**Ans.** : $x^3+y^3=c$]

2. $(1+x)y-(1+y)x\frac{dy}{dx}=0,\ x>0,\ y>0.$

[**Ans.** : $x-y+\log\left(\frac{x}{y}\right)=c$]

3. $(e^x+1)\cos x\,dx+e^x\sin x\,dy=0.$

[**Ans.** : $(e^x+1)\sin x=c$]

4. $y\frac{dy}{dx}=xe^{-x}\sqrt{1-y^2}.$

[**Ans.** : $\sqrt{1-y^2}=(x+1)e^{-x}+c$]

5. $x(e^{4y}-1)\frac{dy}{dx}+(x^2-1)e^{2y}=0,\ x>0.$

[**Ans.** : $\cosh(2y)=\log x-\frac{x^2}{2}+c$]

6. $\frac{dy}{dx}=\frac{x(2\log x+1)}{\sin y+y\cos y}.$

[**Ans.** : $y\sin y=x^2\log x+c$]

7. $\frac{dy}{dx}=\frac{\sin x+\frac{\log x}{x}}{\cos y-\sec^2 y}.$

[**Ans.** : $\sin y-\tan y=-\cos x+\frac{1}{2}(\log x)^2+c$]

8. $y\sec^2 x+(y+7)\tan x\frac{dy}{dx}=0.$

[**Ans.** : $y^7\tan x=ce^{-y}$]

9. $(x+1)\left(\frac{dy}{dx}-1\right)=2(y-x).$

[**Ans.** : $y-x=c(x+1)^2$]

10. $\cos(x+y)dy=dx.$

[**Ans.** : $y-\tan\left(\frac{x+y}{2}\right)=c$]

11. $\frac{dy}{dx}=\frac{y-x}{y-x+2}.$

[**Ans.** : $(y-x)^2=c-4y$]

12. $x\frac{dy}{dx}=y+x^2\tan\left(\frac{y}{x}\right)$

[**Ans.** : $e^{y/x}=x+c$]

14. $(1+x^3)dy-x^2y\,dx=0,\ y(1)=2.$

[**Ans.** : $y^3=4(1+x^3)$]

15. $\frac{dy}{dx}=\frac{x}{y}-\frac{x}{1+y},\ y(0)=2.$

[**Ans.** : $3y^2+2y^3=3x^2+28$]

16. $\frac{dy}{dx}+2y=x^2y,\ y(0)=1.$

[**Ans.** : $y=e^{\frac{x^3}{3}-2x}$]

17. $e^y\left(\frac{dy}{dx}+1\right)=1,\ y(0)=1.$

[**Ans.** : $e^y=1-(1-e)e^{-x}$]

18. $\frac{dy}{dx}=2y\sin^2 x,\ y\left(\frac{\pi}{2}\right)=1.$

[**Ans.** : $\log y=x-\frac{1}{2}\sin 2x-\frac{\pi}{2}$]

19. $\cos y\,dx+(1+e^{-x})\sin y\,dy=0,$

$y(0)=\frac{\pi}{4}.$

[**Ans.** : $\sqrt{2}$]

Solve the following differential equations:

1. $x(y-x)\frac{dy}{dx} = y(y+x)$.

$\left[\text{Ans.}: \frac{y}{x} - \log xy = c\right]$

2. $\frac{dy}{dx} = \frac{3xy + y^2}{3x^2}$.

$[\text{Ans.}: 3x + y\log x + cy = 0]$

3. $x\frac{dy}{dx} = y(\log y - \log x + 1)$.

$\left[\text{Ans.}: \log\frac{y}{x} = cx\right]$

4. $y\,dx + x\log\frac{y}{x}dy - 2x\,dy = 0$.

$\left[\text{Ans.}: y = c\left(1 + \log\frac{x}{y}\right)\right]$

5. $\left(xe^{\frac{y}{x}} - y\sin\frac{y}{x}\right)dx + x\sin\frac{y}{x}dy = 0$.

$\left[\text{Ans.}: \log x^2 - e^{-\frac{y}{x}}\left(\sin\frac{y}{x} + \cos\frac{y}{x}\right) = c\right]$

6. $x\sin\frac{y}{x}dy = \left(y\sin\frac{y}{x} - x\right)dx$.

$\left[\text{Ans.}: \cos\frac{y}{x} = \log x + c\right]$

7. $x\frac{dy}{dx} = y + x\sec\left(\frac{y}{x}\right)$.

$\left[\text{Ans.}: \sin\frac{y}{x} = \log(cx)\right]$

8. $\left(x\tan\frac{y}{x} - y\sec^2\frac{y}{x}\right)dx + x\sec^2\frac{y}{x}dy = 0$.

$\left[\text{Ans.}: x\tan\frac{y}{x} = c\right]$

9. $\left(1+e^{\frac{x}{y}}\right)dx + e^{\frac{x}{y}}\left(1-\frac{x}{y}\right)dy = 0$.

$\left[\text{Ans.}: x + ye^{\frac{x}{y}} = c\right]$

10. $(3xy + y^2)dx + (x^2 + xy)dy = 0$, $y(1) = 1$.

$[\text{Ans.}: x^2y\,(2x+y) = 3]$

11. $2x(x+y)\frac{dy}{dx} = 3y^2 + 4xy$, $y(1) = 1$.

$\left[\text{Ans.}: y^2 + 2xy = 3x^3\right]$

12. $3x\frac{dy}{dx} - 3y + (x^2 - y^2)^{\frac{1}{2}} = 0$, $y(1) = 1$.

$\left[\text{Ans.}: 3\cos^{-1}\left(\frac{y}{x}\right) - \log x = 0\right]$

13. $(x^3 - 3xy^2)dx + (y^3 - 3x^2y)dy = 0$, $y(0) = 1$.

$\left[\text{Ans.}: x^4 - 6x^2y^2 + y^4 = 1\right]$

14. $xy\log\frac{x}{y}dx + \left(y^2 - x^2\log\frac{x}{y}\right)dy = 0$, $y(1) = e$.

$\left[\text{Ans.}: \frac{x^2}{2y^2}\log\frac{x}{y} - \frac{x^2}{4y^2} + \log y = 1 - \frac{3}{4e^2}\right]$

ve the following differential equations:

1. $(x+2y)dx+(3x+6y+3)dy=0.$

[Ans.: $x+3y-3\log|x+2y+3|=c$]

2. $(4x-4y+1)dy-(3x-2y+1)dx=0.$

[Ans.: $4x-8y-\log(12x-8y+1)=c$]

3. $(x+y+3)dy=(x+y-3)dx.$

[Ans.: $-x+y-3\log(x+y)=c$]

4. $(x+y+3)dx-(2x+2y-1)dy=0.$

[Ans.: $-3x+6y-7\log|3x+3y+2|=c$]

5. $(2x+6y+1)dy-(x+3y-2)dx=0.$

[Ans.: $-x+2y+\log|x+3y-1|=c$]

6. $(y-x+2)dy=(y-x)dx.$

[Ans.: $(y-x)^2+4y=c$]

7. $(4x+2y+5)dy-(2x+y-1)dx=0.$

[Ans.: $10y-5x+7\log|10x+5y+9|=c$]

8. $(2x-4y+5)dy-(x-2y+3)dx=0.$

[Ans.: $x^2-4xy+4y^2+6x-10y=c$]

9. $\frac{dy}{dx}=-\frac{2x-y+1}{x+y}.$

[Ans.: $\log\left[2\left(x+\frac{1}{3}\right)^2+\left(y-\frac{1}{3}\right)^2\right]+\sqrt{2}\tan^{-1}\left[\frac{3y-1}{\sqrt{2}(3x+1)}\right]=c$]

10. $(x+y-1)dx-(x-y-1)dy=0.$

[Ans.: $\log[(x-1)^2+y^2]-2\tan^{-1}\left(\frac{y}{x-1}\right)=c$]

11. $(3x-2y+4)dx-(2x+7y-1)dy=0.$

[Ans.: $3x^2-4xy-7y^2+8x+2y=c$]

12. $(x-y-1)dx+(4y+x-1)dy=0.$

[Ans.: $\log[4y^2+(x-1)^2+\tan^{-1}\left(\frac{2y}{x-1}\right)=c$]

13. $(x-y-1)dx+(x+y+5)dy=0.$

[Ans.: $\log\left[(y+3)^2+(x+2)^2\right]+2\tan^{-1}\left(\frac{y+3}{x+2}\right)=c$]

14. $(y-x+2)dx+(x+y+6)dy=0.$

[Ans.: $(y+4)^2+2(x+2)(y+4)-(x+2)^2=c$]

15. $\frac{dy}{dx}=\frac{y+x-2}{y-x-4}.$

[Ans.: $(x+1)^2-(y-3)^2+2(x+1)(y-3)=c$]

16. $\frac{dy}{dx}=\frac{2x+9y-20}{6x+2y-10}.$

[Ans.: $(2x-y)^2=c(x+2y-5)$]

17. $(3x+2y+3)dx-(x+2y-1)dy=0,$
$y(-2)=1.$

[Ans: $(2x+2y+1)(3x-2y+9)^4=-1$]

[Ans.: $\log\left[(x-1)^2+(y+3)^2\right]+2\tan^{-1}\left(\frac{x-1}{y+3}\right)=2\log$

18. $(x+y+2)dx-(x-y-4)dy=0,$
$y(1)=0.$

Solve the following differential equations:

1. $(2x^3+3y)\,dx+(3x+y-1)\,dy=0.$

[**Ans.:** $x^4+6xy+y^2-2y=c$]

2. $(1+e^x)\,dx+y\,dy=0.$

[**Ans.:** $x+e^x+\frac{y^2}{2}=c$]

3. $\sinh x\cos y\,dx-\cosh x\sin y\,dy=0.$

[**Ans.:** $\cosh x\cos y=c$]

4. $xe^{x^2+y^2}\,dx+y(1+e^{x^2+y^2})dy=0,$
$y(0)=0.$

[**Ans.:** $y^2+e^{x^2+y^2}=1$]

5. $\left(4x^3y^3+\frac{1}{x}\right)dx+\left(3x^4y^2-\frac{1}{y}\right)dy=0,$
$y(1)=1.$

[**Ans.:** $x^4y^3+\log\left(\frac{x}{y}\right)=1$]

6. $(4x^3y^3dx+3x^4y^2dy)$
$-(2xy\,dx+x^2dy)=0.$

[**Ans.:** $x^4y^3-x^2y=c$]

7. $2x(ye^{x^2}-1)dx+e^{x^2}dy=0.$

[**Ans.:** $ye^{x^2}-x^2=c$]

8. $\left(1+x^2\sqrt{y}\right)y\,dx+\left(x^2\sqrt{y}+2\right)x\,dy=0.$

[**Ans.:** $2xy+\frac{2}{3}x^3y^{\frac{3}{2}}=c$]

9. $(e^x+1)\cos x\,dx+e^x\sin x\,dy=0.$

[**Ans.:** $\sin x(e^x+1)=c$]

10. $(x^2+1)\frac{dy}{dx}=x^3-2xy+x.$

[**Ans.:** $x^4-4x^2y+2x^2-4y=c$]

11. $\frac{dy}{dx}=\frac{x^2-2xy}{x^2-\sin y}.$

[**Ans.:** $x^3-3(x^2y+\cos y)=c$]

12. $\frac{dy}{dx}=\frac{y+1}{(y+2)e^y-x}.$

[**Ans.:** $(y+1)(x-e^y)=c$]

13. $(x-y\cos x)dx-\sin x\,dy=0,$
$y\left(\frac{\pi}{2}\right)=1.$

[**Ans.:** $x^2-2y\sin x=\frac{\pi^2}{4}-2$]

14. $(2xy+e^y)\,dx+(x^2+xe^y)dy=0,$
$y(1)=1.$

[**Ans.:** $x^2y+xe^y=e+1$]

Exercise 10.6

the following differential equations:

$\frac{dy}{dx} = 3x^2 - 2xy + 1$

$\left[\text{Ans.}: y = \frac{c}{x^2} + x + \frac{1}{x}\right]$

$(2y - 3x)dx + x\,dy = 0$

$\left[\text{Ans.}: x^2 y = x^3 + c\right]$

$(x+1)\frac{dy}{dx} - 2y = (x+1)^4$

$\left[\text{Ans.}: y = \left(\frac{x^2}{2} + x + c\right)(x+1)^2\right]$

$\frac{dy}{dx} + y\cot x = \cos x$

$\left[\text{Ans.}: y\sin x = \frac{\sin^2 x}{2} + c\right]$

$\frac{1}{x}\frac{dy}{dx} + 2y = e^{-x^2}$

$\left[\text{Ans.}: ye^{x^2} = \frac{x^2}{2} + c\right]$

$(y+1)dx + [x - (y+2)e^y]dy = 0$

$\left[\text{Ans.}: (y+1)(x - e^y) = c\right]$

$dx + x\,dy = e^{-y}\sec^2 y\,dy$

8. $(1+x)\frac{dy}{dx} - y = e^x(x+1)^2$

$\left[\text{Ans.}: y = (1+x)(e^x + c)\right]$

9. $\left(\frac{e^{-2\sqrt{x}}}{\sqrt{x}} - \frac{y}{\sqrt{x}}\right)\frac{dx}{dy} = 1$

$\left[\text{Ans.}: ye^{2\sqrt{x}} = 2\sqrt{x} + c\right]$

10. $x\cos x\frac{dy}{dx} + y(x\sin x + \cos x) = 1$

$\left[\text{Ans.}: xy = \sin x + c\cos x\right]$

11. $\cos^2 x\frac{dy}{dx} + y = \tan x$

$\left[\text{Ans.}: y = \tan x - 1 + ce^{-\tan x}\right]$

12. $(2x + y^4)\frac{dy}{dx} = y$

$\left[\text{Ans.}: \frac{2x}{y^2} = y^2 + c\right]$

13. $\sqrt{a^2 + x^2}\frac{dy}{dx} + y = \sqrt{a^2 + x^2} - x$

$\left[\text{Ans.}: \left(x + \sqrt{x^2 + a^2}\right)y = a^2 x + c\right]$

14. $\frac{dy}{dx} = \frac{1}{x + e^y}$

$\left[\text{Ans.}: xe^{-y} = c + y\right]$

15. $\frac{dy}{dx} - \left(\frac{3}{x}\right)y = x^3,\ y(1) = 4$

$\left[\text{Ans.}: y = x^3(x+3)\right]$

16. $(1+x^2)\frac{dy}{dx} - 2xy = 2x(1+x^2),$
$y(0) = 1$

$\left[\text{Ans.}: y = (1+x^2)[1 + \log(1+x^2)]\right]$

17. $x\frac{dy}{dx} - 3y = x^4(e^x + \cos x) - 2x^2,$
$y(\pi) = \pi^3 e^\pi + 2\pi^2$

$\left[\text{Ans.}: y = 2x^2 + (e^x + \sin x)x^3\right]$

18. If $\frac{dy}{dx} + 2y\tan x = \sin x,\ y\left(\frac{\pi}{3}\right) = 0$

show that maximum value of y is $\frac{1}{4}$.

19. $\frac{dy}{dx} + \frac{y}{x} = \log x,\ y(1) = 1$

$\left[\text{Ans.}: y = \frac{x\log x}{2} - \frac{x}{4} + \frac{5}{4x}\right]$

20. $\frac{dy}{dx} + 2xy = xe^{-x^2}$

$\left[\text{Ans.}: ye^{x^2} = \frac{x^2}{2} + c\right]$

ve the following differential equations:

$\frac{dy}{dx} = x^3y^3 - xy$

$\left[\text{Ans.}: \frac{1}{y^2} = x^2 + 1 + ce^{x^2}\right]$

$x^2y - x^3\frac{dy}{dx} = y^4\cos x$

$\left[\text{Ans.}: x^3 = y^3(3\sin x - c)\right]$

$(1+2y^2)dx + 2y(1+x^2)dy = 0$

$\left[\text{Ans.}: y^2(1+x^2) = -x^3 + c\right]$

$x(1-3x^2y^2)dy = 0$

$\left[\text{Ans.}: y^6 = ce^{-\frac{1}{x^2y^2}}\right]$

$[y + xy^3(1+\log x)]dx = 0$

$\left[\text{Ans.}: x^2 = -\frac{2}{3}x^3y^2\left(\frac{2}{3} + \log x\right) + cy^2\right]$

6. $\frac{dy}{dx} + y = y^2e^x$

$\left[\text{Ans.}: -\frac{e^{-x}}{y} = x + c\right]$

7. $x\,dy + y\,dx = x^3y^3\,dx$

$\left[\text{Ans.}: \frac{2}{y^2} = 5x^3 + cx^4\right]$

8. $x\frac{dy}{dx} + y = y^3x^{n+1}$

$\left[\text{Ans.}: \frac{n-1}{y^2} = cx^2 - 2x^{n+1}\right]$

9. $xy(1+x^2y^2)\frac{dy}{dx} = 1$

$\left[\text{Ans.}: \frac{1}{x^2} = ce^{-y^2} - y^2 + 1\right]$

10. $x^2y^3\,dx + (x^3y - 2)\,dy = 0$

$\left[\text{Ans.}: x^3 = \frac{2}{y} + \frac{2}{3} + ce^{\frac{3}{y}}\right]$

11. $y\frac{dx}{dy} = x - yx^2\cos y$

$\left[\text{Ans.}: \frac{y}{x} = y\sin y + \cos y + c\right]$

12. $\frac{dy}{dx} = \frac{e^x}{x^2} - \frac{1}{x}$

$\left[\text{Ans.}: 2xe^{-y} = 1 + 2cx^2\right]$

13. $y\frac{dy}{dx} + \frac{4}{3}x - \frac{y^2}{3x} = 0$

$\left[\text{Ans.}: y^2x^{-\frac{2}{3}} + 2x^{\frac{4}{3}} = c\right]$

14. $\frac{dy}{dx} + (2x\tan^{-1}y - x^3)(1+y^2) = 0$

$\left[\text{Ans.}: 2\tan^{-1}y = (x^2-1) + ce^{-x^2}\right]$

15. $\tan y\frac{dy}{dx} + \tan x = \cos y\cos^2 x$

$\left[\text{Ans.}: \sec y\sec x = \sin x + c\right]$

16. $(y + e^x - e^{-x})dx + (1+e^y)dy = 0$

$\left[\text{Ans.}: y + e^y = (x+c)e^{-x}\right]$

17. $x^2\cos y\frac{dy}{dx} = 2x\sin y - 1$

$\left[\text{Ans.}: 3x\sin y = cx^3 + 1\right]$

18. $4x^2y\frac{dy}{dx} = 3x(3y^2+2) + 2(3y^2+2)$

$\left[\text{Ans.}: 4x^9 = (3y^2+2)^2(-3x^3+c)\right]$

19. $\frac{dy}{dx} + \frac{1}{x}\tan y = \frac{1}{x^2}\tan y\sin y$

$\left[\text{Ans.}: \operatorname{cosec} y = 1 + cx\right]$

20. $x\frac{dy}{dx} + 3y = x^4e^{\frac{1}{x^2}}y^3$

$\left[\text{Ans.}: \frac{1}{y^2} = \left(e^{\frac{1}{x^2}} + c\right)x^4\right]$

21. $x^2\frac{dy}{dx} = \sin^2 y - (\sin y\cos y)x$

$\left[\text{Ans.}: \cot y = \frac{1}{2x} + c\right]$

22. $\frac{dr}{d\theta} = \frac{r\sin\theta - r^2}{\cos\theta}$

$\left[\text{Ans.}: \frac{1}{r} = c\cos\theta + \sin\theta\right]$

23. $\cos x\frac{dy}{dx} + 4y\sin x = 4\sqrt{y}\sec x$

$\left[\text{Ans.}: \sqrt{y}\sec^2 x = 2\left(\tan x + \frac{\tan^3 x}{3}\right) + c\right]$

24. $\sin y\frac{dy}{dx} = \cos x(2\cos y - \sin^2 x)$

$\left[\text{Ans.}: 4\cos y = 2\sin^2 x - 2\sin x + 1 - 4ce^{-2\sin x}\right]$

25. $e^y\left(\frac{dy}{dx} + 1\right) = e^x$

$\left[\text{Ans.}: e^{x+y} = \frac{e^{2x}}{2} + c\right]$

Exercise 10.8

Solve the following differential equations:

1. $(D^2+D-2)y=0.$

[**Ans.** : $y=c_1e^{-2x}+c_2e^{x}$]

2. $(4D^2+8D-5y)=0.$

[**Ans.** : $y=c_1e^{\frac{x}{2}}+c_2e^{-\frac{5x}{2}}$]

3. $(D^2-4D-12)y=0.$

[**Ans.** : $y=c_1e^{6x}+c_2e^{-2x}$]

4. $(D^2+2D-8)y=0.$

[**Ans.** : $y=c_1e^{2x}+c_2e^{-4x}$]

5. $(D^2+4D+1)y=0.$

[**Ans.** : $y=c_1e^{(-2+\sqrt{3})x}+c_2e^{(-2-\sqrt{3})x}$]

6. $(4D^2+4D+1)y=0.$

[**Ans.** : $y=(c_1+c_2x)e^{-\frac{x}{2}}$]

7. $(D^2+2\pi D+\pi^2)y=0.$

[**Ans.** : $y=(c_1+c_2x)e^{-\pi x}$]

8. $(9D^2-12D+4)y=0.$

[**Ans.** : $y=(c_1+c_2x)e^{\frac{2x}{3}}$]

9. $(25D^2-20D+4)y=0.$

[**Ans.** : $y=(c_1+c_2x)e^{\frac{2x}{5}}$]

10. $(9D^2-30D+25)y=0.$

[**Ans.** : $y=(c_1+c_2x)e^{\frac{5x}{3}}$]

11. $(D^2-6D+25)y=0.$

[**Ans.** : $y=e^{3x}(c_1\cos 4x+c_2\sin 4x)$]

12. $(D^2+6D+11)y=0.$

[**Ans.** : $y=e^{-3x}(c_1\cos\sqrt{2}x+c_2\sin\sqrt{2}x)$]

13. $[D^2-2aD+(a^2+b^2)y]=0.$

[**Ans.** : $y=e^{ax}(c_1\cos bx+c_2\sin bx)$]

14. $(D^3-9D)y=0.$

[**Ans.** : $y=c_1+c_2e^{3x}+c_3e^{-3x}$]

15. $(D^3-3D^2-D+3)y=0.$

[**Ans.** : $y=c_1e^{-x}+c_2e^{x}+c_3e^{3x}$]

16. $(D^3-6D^2+11D-6)y=0.$

[**Ans.** : $y=c_1e^{x}+c_2e^{2x}+c_3e^{3x}$]

17. $(D^3-6D^2+12D-8)y=0.$

[**Ans.** : $y=(c_1+c_2x+c_3x^2)e^{2x}$]

18. $(D^3+D)y=0.$

[**Ans.** : $y=c_1+c_2\cos x+c_3\sin x$]

19. $(D^3+5D^2+8D+6)y=0.$

[**Ans.** : $y=c_1e^{-3x}+e^{-x}(c_2\cos x+c_3\sin x)$]

20. $(8D^4-6D^3-7D^2+6D-1)y=0.$

[**Ans.** : $y=c_1e^{\frac{1}{2}}+c_2e^{\frac{1}{2}}+c_3e^{x}+c_4e^{-x}$]

21. $(D^4-2D^3+D^2)y=0.$

[**Ans.** : $y=c_1+c_2x+(c_3+c_4x)e^{x}$]

22. $(D^4-3D^3+3D^2-D)y=0.$

[**Ans.** : $y=c_1+(c_2+c_3x+c_4x^2)e^{x}$]

23. $(D^4+8D^2-9)y=0.$

[**Ans.** : $y=c_1e^{x}+c_2e^{-x}+c_3\cos 3x+c_4\sin 3x$]

24. $(D^4+D^3+14D^2+16D-32)y=0.$

[**Ans.** : $y=c_1e^{x}+c_2e^{-2x}+c_3\cos 4x+c_4\sin 4x$]

25. $(D^4+2D^3-9D^2-10D+50)y=0.$

[**Ans.** : $y=e^{2x}(c_1\cos x+c_2\sin x)+e^{-3x}(c_3\cos x+c_4\sin x)$]

26. $(D^4+18D^3+81)y=0.$

[**Ans.** : $y=(c_1+c_2x)\cos 3x+(c_3+c_4x)\sin 3x$]

27. $(D^4-4D^3+14D^2-20D+25)y=0.$

[**Ans.** : $y=e^{x}[(c_1+c_2x)\cos 2x+(c_3+c_4x)\sin 2x]$]

28. $(D^2+D-2)y=0, y(0)=4, y'(0)=-5.$

[**Ans.** :

29. $(4D^2+12D+9)y=0,$
$y(0)=-1, y'(0)=2$

[**Ans.** : $y=\left(\frac{x}{2}\right.$

30. $(D^2-4D+5)y=0,$
$y(0)=2, y'(0)=-1$

[**Ans.** : $y=e^{2x}(2\cos x-5\sin$

31. $(9D^2-6D+1)y=0,$
$y(1)=e^{\frac{1}{3}}, y(2)=1.$

[**Ans.** :
$y=\left[\left(e^{-\frac{2}{3}}-1\right)x+\left(2-e^{\frac{2}{3}}\right.\right.$

32. $(4D^3-4D^2-9D+9)y=0,$
$y(0)=1, y'(0)=0, y''(0)=0$

[**Ans.** : $y=\frac{1}{5}\left(9e^{x}-5e^{\frac{3x}{2}}+e^{\right.$

33. $(D^3+D^2-2)y=0, y(0)=2,$
$y'(0)=2, y''(0)=-3.$

[**Ans.** : $y=e^{x}+e^{-x}(\cos x+2\sin$

34. $(D^4-3D^3)=0, y(0)=2,$
$y'(0)=5, y''(0)=15, y'''(0)=$

[**Ans.** : $y=1+2x+3x^2+$

35. $(D^4-3D^3+2D^2)y=0, y(0)=$
$y'(0)=0, y''(0)=2, y'''(0)=$

[**Ans.** : $y=2(e^{x}-$

Solve the following differential equations using variation of parameter method

1. $(D^2+1)y = \tan x$.

[**Ans.** : $y = c_1 \cos x + c_2 \sin x - \cos x \log(\sec x + \tan x)$]

2. $(D^2+4)y = \sec^2 2x$.

[**Ans.** : $y = c_1 \cos 2x + c_2 \sin 2x - \frac{1}{4} + \frac{\sin 2x}{4} \log(\sec 2x + \tan 2x)$]

3. $(D^2+1)y = \text{cosec}\cot x$.

[**Ans.** : $y = c_1 \cos x + c_2 \sin x - \cos x \log|\sin x| - x \sin x - \sin x \cot x$]

4. $(D^2+1)y = \frac{1}{1+\sin x}$.

[**Ans.** : $y = c_1 \cos x + c_2 \sin x - (1 - \sin x + x\cos x) + \sin x \log(1+\sin x)$]

5. $(D^2-1)y = \frac{2}{1-e^x}$.

[**Ans.** : $y = c_1 e^x + c_2 e^{-x} + e^x \log(1+e^{-x}) - e^x - 1 - e^{-x}\log(1+e^x)$]

6. $(D^2-6D+9)y = \frac{e^{3x}}{x^2}$.

[**Ans.** : $y = (c_1 + c_2 x)e^{3x} - (1+\log x)e^{3x}$]

7. $(D^2-1)y = 2(1-e^{-2x})^{-\frac{1}{2}}$.

[**Ans.** : $y = c_1 e^x + c_2 e^{-x} - e^x \sin^{-1}(e^{-x}) - (e^{2x}-1)^{\frac{1}{2}} e^{-x}$]

8. $(D^2-2D)y = e^x \sin x$.

[**Ans.** : $y = c_1 + c_2 e^{2x} - \frac{e^x}{2}\sin x$]

9. $(D^2+3D+2)y = e^x + x^2$.

[**Ans.** : $y = c_1 e^{-x} + c_2 e^{-2x} + \frac{e^x}{6} + \left(\frac{x^2}{2} - \frac{3x}{2} + \frac{7}{4}\right)$]

10. $(D^2-2D+1)y = x^{\frac{3}{2}} e^x$.

[**Ans.** : $y = (c_1 + c_2 x)e^x + \frac{4}{35}x^{\frac{7}{2}}e^x$]

11. $(D^2-3D+2)y = xe^x + 2x$.

[**Ans.** : $y = c_1 e^x + c_2 e^{2x} - \frac{x^2}{2}e^x - xe^{-x} + x + \frac{3}{2}$]

12. $(D^2+1)y = x\cos 2x$.

[**Ans.** : $y = c_1 \cos x + c_2 \sin x - \frac{x}{2}\cos 2x + \frac{4}{9}\sin 2x$]

13. $(D^2+1)y = \log\cos x$.

[**Ans.** : $y = c_1 \cos x + c_2 \sin x + (\log\cos x - 1) + \sin x \log(\sec x + \tan x)$]

14. $(D^2+4D+8)y = 16e^{-2x}\sec^2 2x$

[**Ans.** : $y = e^{-2x}(c_1 \cos 2x + c_2 \sin 2x) + 4e^{-2x}\cos 2x \log|\text{cosec}\, 2x + \cot 2x| - 4e^{-2x}$]

Solve the following differential equations:

1. $\frac{dx}{dt} = 3x + 8y, \qquad \frac{dy}{dt} = -x - 3y$

[**Ans.** : $x = -4c_1e^{t} - 2c_2e^{-t}$, $y = c_1e^{t} - c_2e^{-t}$]

2. $\frac{dx}{dt} = 2y - 1, \qquad \frac{dy}{dt} = 1 + 2x$

[**Ans.** : $x = c_1e^{2t} + c_2e^{-2t} - \frac{1}{2}$, $y = c_1e^{2t} - c_2e^{-2t} + \frac{1}{2}$]

3. $(D + 6)y - Dx = 0, (3 - D)x - 2Dy = 0$ with $x = 2, y = 3$ at $t = 0$

[**Ans.** : $x = 4e^{2t} - 2e^{-3t}$, $y = e^{2t} + 2e^{-3t}$]

4. $\frac{dx}{dt} + y - 1 = \sin t, \quad \frac{dy}{dt} + x = \cos t$

[**Ans.** : $x = c_1e^{t} + c_2e^{-t}$, $y = 1 + \sin t - c_1e^{t} + c_2e^{-t}$]

5. $(D + 5)x + (D + 7)y = 2e^{t}$,
$(2D + 1)x + (3D + 1)y = e^{t}$

[**Ans.** : $x = \frac{1}{1+5t}\left\{(2 - 8c_2)e^{t} + \frac{5}{2}c_2e^{-t}\right.$, $y = c_1e^{-2t} + c_2e^{t}$]

6. $\frac{d^2x}{dt^2} + y = \sin t, \quad \frac{d^2y}{dt^2} + x = \cos t$

[**Ans.** : $x = c_1e^{t} + c_2e^{-t} + c_3\cos t + c_4\sin t - \frac{t}{4}\cos t + \frac{t}{4}\sin t$, $y = -c_1e^{t} - c_2e^{-t} + c_3\cos t + c_4\sin t + \frac{1}{4}(2 + t)(\sin t - \cos t)$]

7. $D^2x + 3x - 2y = 0$, $D^2x + D^2y - 3x + 5y = 0$ with $x = 0, y = 0, Dx = 3, Dy = 2$ when $t = 0$

[**Ans.** : $x = \frac{1}{4}(11\sin t + \frac{1}{3}\sin 3t)$, $y = \frac{1}{4}(11\sin t - \sin 3t)$]

$(D^2+3D+2)y = 12e^{-x}\sin^3 x.$

$\left[\text{Ans.: } y = c_1e^{-x} + c_2e^{-2x} + \frac{e^{-x}}{10}[(\cos 3x + 3\sin 3x) - 45(\cos x + \sin x)]\right]$

$(D^2+4D+3)y = 6e^{-x}.$

$\left[\text{Ans.: } y = c_1e^{-x} + c_2e^{-3x} + 3xe^{-x}\right]$

$(D^2-D-6)y = 5e^{-2x} + 10e^{3x}.$

$\left[\text{Ans.: } y = c_1e^{3x} + c_2e^{-2x} + 2xe^{3x} - xe^{-2x}\right]$

$(D^2+16)y = 16\sin 4x.$

$\left[\text{Ans.: } y = c_1\cos 4x + c_2\sin 4x - 2x\cos 4x\right]$

$(D^2+25)y = 50\cos 5x + 30\sin 5x.$

$\left[\text{Ans.: } y = c_1\cos 5x + c_2\sin 5x - x(3\cos 5x - 5\sin 5x)\right]$

$(D^3-2D^2+4D-8)y = 8(x^2+\cos 2x)$

$\left[\text{Ans.: } y = c_1e^{2x} + c_2\cos 2x + c_3\sin 2x - (x^2+x) - \frac{x}{2}(\cos 2x + \sin 2x)\right]$

$(D^2-4D+5)y = 16e^{2x}\cos x.$

$\left[\text{Ans.: } y = e^{2x}(c_1\cos x + c_2\sin x) + 8xe^{2x}\sin x\right]$

$(D^2-6D+13)y = 6e^{3x}\sin x\cos x.$

$\left[\text{Ans.: } y = e^{3x}(c_1\cos 2x + c_2\sin 2x) - \frac{3x}{4}e^{3x}\cos 2x\right]$

$(D^3+2D^2-D-2)y = e^x + x^2.$

$\left[\text{Ans.: } y = c_1e^x + c_2e^{-x} + c_3e^{-2x} + \frac{1}{6}xe^x - \frac{x^2}{2} + \frac{x}{2} - \frac{5}{4}\right]$

22. $(D^2-4D+4)y = x^3e^{2x} + xe^{2x}.$

$\left[\text{Ans.: } y = (c_1+c_2x)e^{2x} + \left(\frac{x^5}{20} + \frac{x^3}{6}\right)e^{2x}\right]$

23. $(D^2-3D+2)y = xe^{2x} + \sin x.$

$\left[\text{Ans.: } y = c_1e^x + c_2e^{2x} + \left(\frac{x^2}{2} - x\right)e^{2x} + \frac{1}{10}\sin x + \frac{3}{10}\cos x\right]$

24. $(D^2+1)y = \sin^3 x.$

$\left[\text{Ans.: } y = c_1\cos x + c_2\sin x + \frac{1}{32}\sin 3x - \frac{3}{8}x\cos x\right]$

25. $(D^2+2D+1)y = x^2e^{-x}.$

$\left[\text{Ans.: } y = (c_1+c_2x)e^{-x} + \frac{x^4}{12}e^{-x}\right]$

26. $(D^3-D^2-4D+4)y = 2x^2 - 4x - 1 + 2x^2e^{2x} + 5xe^{2x} + e^{2x}.$

$\left[\text{Ans.: } y = c_1e^x + c_2e^{2x} + c_3e^{-2x} + \frac{x^2}{2} + \frac{x^3}{6}e^{2x}\right]$

27. $(D^2-5D-6)y = e^{3x},$
$y(0) = 2, \quad y'(0) = 1$

$\left[\text{Ans.: } y = \frac{10}{21}e^{6x} + \frac{45}{28}e^{-x} - \frac{1}{12}e^{3x}\right]$

28. $(D^2-5D+6)y = e^x(2x-3),$
$y(0) = 1,\ y'(0) = 3.$

$\left[\text{Ans.: } y = e^{2x} + xe^x\right]$

29. $(D^3-D)y = 4e^{-x} + 3e^{2x},$
$y(0) = 0,\ y'(0) = -1,\ y''(0) = 2.$

Solve the following differential equations using method of undetermined coefficients.

1. $(D^2+6D+8)y = e^{-3x}+e^{x}$.

[**Ans.** : $y = c_1e^{-2x}+c_2e^{-4x}-e^{-3x}+\frac{e^{x}}{15}$]

2. $(4D^2-1)y = e^{x}+e^{3x}$.

[**Ans.** : $y = c_1e^{\frac{x}{2}}+c_2e^{-\frac{x}{2}}+\frac{1}{105}(35e^{x}+3e^{3x})$]

3. $(D^2+D-6)y = 39\cos 3x$.

[**Ans.** : $y = c_1e^{2x}+c_2e^{-3x}+\frac{1}{2}(\sin 3x-5\cos 3x)$]

4. $(D^2+2D+5)y = 6\sin 2x+7\cos 2x$.

[**Ans.** : $y = e^{-x}(c_1\cos 2x+c_2\sin 2x)+2\sin 2x-\cos 2x$]

5. $(D^2+4D-5)y = 34\cos 2x-2\sin 2x$.

[**Ans.** : $y = c_1e^{x}+c_2e^{-5x}+2(\sin 2x-\cos 2x)$]

6. $(D^3-D^2+D-1)y = 6\cos 2x$.

[**Ans.** : $y = c_1e^{x}+c_2\cos x+c_3\sin x+\frac{2}{5}(\cos 2x-2\sin 2x)$]

7. $(2D^3-D-3)y = x^3+x+1$.

[**Ans.** : $y = c_1e^{-x}+c_2e^{\frac{3x}{2}}-\frac{1}{27}(9x^3-9x^2+51x-23)$]

8. $(D^2+4)y = 8x^2$.

[**Ans.** : $y = c_1\cos 2x+c_2\sin 2x+2x^2-1$]

9. $(3D^2+2D-1)y = e^{-2x}+x$.

[**Ans.** : $y = c_1e^{-x}+c_2e^{\frac{x}{3}}+\frac{1}{7}(e^{-2x}-7x-14)$]

10. $(D^2-2D+3)y = x^2+\sin x$.

[**Ans.** : $y = e^{x}\left(c_1\cos\sqrt{2}x+c_2\sin\sqrt{2}x\right)+\frac{1}{27}(9x^2+6x-8)+\frac{1}{4}(\sin x+\cos x)$]

11. $(D^4-1)y = x^4+1$.

[**Ans.** : $y = c_1e^{x}+c_2e^{-x}+c_3\cos x+c_4\sin x-x^4-25$]

12. $(D^2-1)y = e^{3x}\cos 2x-e^{2x}\sin 2x$.

[**Ans.** : $y = c_1e^{x}+c_2e^{-x}+\frac{1}{30}e^{2x}(2\cos 3x+\sin 3x)+\frac{1}{40}e^{3x}(\cos 2x+3\sin 2x)$]