2023-24

B.Tech. (ODD SEMESTER) EXAMINATION

(ELECTRICAL ENGINEERING)

POWER SYSTEM PROTECTION

(EEC4310)

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Answer all questions.

Assume suitable data if missing.

Notations and symbols used have their usual meaning.

Q.No.	Question	CO	M.M.
1(a)	An earth fault develops at point F on the feeder shown in the Fig.1, and the fault current is 16000 A. The IDMT relays at points A and B are fed via 600/5 A CTs: The relay at B has a plug setting of 120% and time multiplier setting (TMS) of 0.1. The circuit breakers take 0.25 s to clear the fault, and the relay error in each case is 0.12 s.	CO-1	7

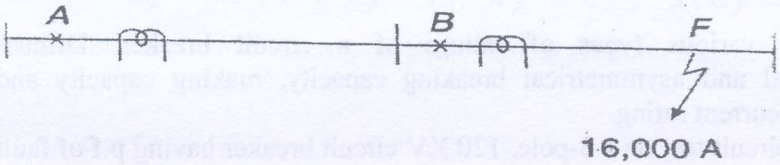

Fig.1

For a plug setting of 200% on the relay A, determine the minimum TMS on that relay for it not to operate before the circuit breaker at B has cleared the fault. A relay operating time curve is shown in Fig.2.

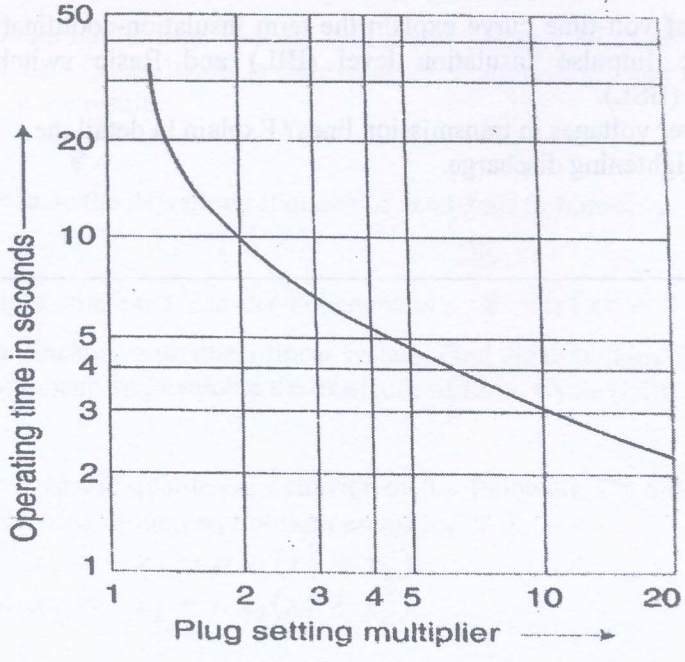

Fig.2

contd....2.

1(b)	Discuss the effect of arc resistance on the performance of different types of distance relays. Also compare different types of distance relays.	CO-1	8
	OR		
1(b')	Draw the schematic diagram of a numerical relay and briefly describe the functions of its various components.	CO-1	8
2(a)	Explain harmonic restraint differential protection scheme for transformers.	CO-2	8
	OR		
2(a')	Explain Merz-price differential protection scheme of alternator for external and internal faults.	CO-2	8
2(b)	A 11KV 3- phase turbo alternator has a maximum continuous rating of 4000 KW at 0.7 p.f and its reactance is 11%. It is equipped with differential protection which is set to operate at a fault current of minimum 180A. Find the value of neutral resistance required to protect 90% of the winding.	CO-2	7
3(a)	What are the different types of air blast circuit breaker? Discuss their operating principle and area of applications. Which type is less affected by current chopping?	CO-3	8
	OR		
3(a')	Enumerate various types of ratings of a circuit breaker. Discuss symmetrical and asymmetrical breaking capacity, making capacity and short-time current rating.	CO-3	8
3(b)	In a short circuit test on a 3-pole, 120 KV circuit breaker having p.f of fault was 0.3 and the recovery voltage was 0.8 times full line value. The breaking current was symmetrical. The frequency of oscillation of restriking voltage was 15KHz. Estimate the average RRRV. When (a) the neutral is grounded and the fault involves earth (b) neutral is grounded but fault does not involve ground.	CO-3	7
4(a)	With the help of volt-time curve explain the term insulation-coordination. Describe Basic Impulse Insulation level (BIL) and Basic switching Insulation level (BSL).	CO-4	8
4(b)	What are the over voltages in transmission lines? Explain in detail the Phenomena of lightening discharge.	CO-4	7

2023-24

B. Tech. (ODD SEMESTER) EXAMINATION

(ELECTRICAL ENGINEERING)

CONTROL SYSTEMS

(EEC-4410)

Max Marks: 60 Duration: 2 Hours

Note:

(i) Answer All questions.

(ii) Assume suitable data if missing.

(iii) Notations used have their usual meaning.

Q.No.	Question	M.M.
1(a)	Convert a C.T. signal $X(t) = \sin(200\pi t) + \cos(75\pi t)$ into discrete time signal with sampling frequency 300Hz, 150Hz and 50Hz. Reconstruct the signal and comment upon the result. (CO-1)	[7]
1(b)	Solve the difference equation $x(k+2) - 3x(k+1) + 2x(k) = 4^k \; ; \;\; x(0) = 0, \;\; x(1) = 1.$ Indicate initial condition response and forcing function response. (CO-1)	[8]
2(a)	Co-relate Observability with Detectability (CO-2)	[6]
2(b)	For the system represented by the state model $x' = Ax + Bu; \quad y = Cx;$ Where $A = \begin{bmatrix} 1 & 2 \\ 1 & 01 \end{bmatrix}; \; B = \begin{bmatrix} -2 \\ 3 \end{bmatrix}$; and $C = [1 \quad 1]$ Determine the Eigen vector Matrix and Transfer Function of the given system and evaluate Controllability, Observability, Stabilizability and Detectability. Comments upon the result. (CO-2)	[9]
3(a)	Evaluate the describing function of dead-zone nonlinearity. (CO-3)	[8]
	OR	
3(a')	Approximate the Van-der-Pol equation's $\ddot{x} - \alpha(x^2 - 1)\dot{x} + 2x = 0.$ non-linearity with quasi-linear system. Find the describing function of Non-linear component and evaluate the existence of Limit Cycle (LC). (CO-3)	[8]
3(b)	Analyze the qualitative behavior of the following 2nd order non-linear system by linearizing around equilibrium points for $\forall \mu$ $x_1' = -x_2 - \mu x_1(x_1^2 + x_2^2).$; and $x_2' = x_1 - \mu x_2(x_1^2 + x_2^2).$ (CO-3)	[7]
	OR	

Contd.... 2.

3(b') Explain the following with examples: [7]

(i) Limit Cycle.
(ii) Bifurcation.
(iii) Chaos.

(CO-3)

4(a) A 2nd order system described by [8]

$x_1' = -x_1 + x_2.$;
and $x_2' = -x_1 - x_2.$
Determine the following
(i) Nullclines.
(ii) Nature of Equilibrium points.
(iii) Magnitude and direction of field at-least at two points in each quadrant of phase plane.
(iv) Draw the rough field sketch in the phase plane.

(CO-4)

OR

4(a') A 2nd order system described by [8]

$x_1' = \mu - x_1^2.$;
and $x_2' = -x_2.$
Determine the Equilibrium point for $\mu < 0$; $\mu = 0$; and $\mu > 0$. Also sketch rough phase portrait for $\mu = 1$.

(CO-4)

4(b) A 2nd order system given by the state model $x' = Ax$; [7]

Where $A = \begin{bmatrix} 1 & 2 \\ 1 & 01 \end{bmatrix}$. Assume Q as Identity matrix, Solve for P using the equation $A^T P + PA = -Q$. Determine the Stability by applying Lyapunov's theorem and write Lyapunov's function.

(CO-4)

OR

4(b') Define the following and co-relate these with location of poles. [7]

(i) Nodes.
(ii) Focus Point.
(iii) Saddle Point.
(iv) Center.

(CO-4)

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B.Tech(ODD SEMESTER) EXAMINATION

(ELECTRICAL ENGINEERING)

POWER STATION PRACTICE

(EEE4310)

Max Marks: 60 Duration: 2 Hours

Note:

1. Notations used have their usual meaning
2. Any missing data may be suitably assumed

1(a) Differentiate between load duration curve and energy load curve. What is utility of such curves? Explain using suitable curves. CO1 06

1(b) A steam plant has two 120 MW units. The cost data is as under:

Head	Unit 1	Unit 2
Unit Cost (Rs./kW)	20000	32000
Fixed charge rate (%)	10	10
Capacity factor	0.60	0.65
Fuel consumption (kg/kWh)	0.7	0.6
Fuel cost (Rs/kg)	1.6	1.6
Operating & Maintenance Cost	20% of annual fuel cost	15% of annual fuel cost
Utilization factor	1	1

CO1 09

Calculate (i) annual plant cost and generation cost of unit 1
(ii) annual plant coat and generation cost of unit 2
(iii) overall generation cost of the plant

OR

1'(a) What is load forecasting as applicable to power system? Discuss the five components of short term load forecasting. CO1 06

1'(b) A region has a maximum demand of 600MW at a load factor of 50%. The load duration curve can be assumed to be a triangle. The utility has to meet this load by setting up a generating system which is partly hydro and partly steam. The costs are as under:
Hydro plant: Rs 7500 per kW per annum + operating expenses of Rs. 0.40 per kWh CO1 09
Steam plant: Rs 4000 per kW per annum + operating expenses of Rs. 1.60 per kWh

Determine the capacity of hydro plant, capacity of steam plant, energy generated annually by each plant.

2(a) Using suitable phasor diagram find out the most economical power factor when kW demand is constant CO2 06

2 (b) An industrial consumer has an annual energy consumption of 200 MWh at load factor of 0.40. The tariff is Rs. 5000 + Rs. 1500 per kW of maximum demand + Rs. 3.05 per kWh.

(i) Find annual bill of the consumer
(ii) What is the bill if total energy consumption is the same but load factor is improved to 0.60? CO2 09
(iii) What is the bill if energy consumption is reduced by 30% and load factor remains the same at initial value of 0.40?

Contd....2.

(iv) Find average energy cost in each case.

OR

2'(a) Using suitable block diagram explain a 'time of day tariff' scheme. CO2 06

2'(b) A power station has an induction generator giving a constant output power of 2 MW at 0.88 power factor leading. In addition there is a synchronous generator. Find the power factor of synchronous generator when the total load on the station is CO2 09

(i) 10 MW at 0.82 lagging power factor

(ii) 5 MW at 0.82 lagging power factor

3(a) What is the necessity of reactive power control in a power system? Why are AVR's used? Explain briefly CO3 06

3 (b) The daily load curve data for a certain area is as under:

Time	Load (MW)
12 midnight – 5 am	100
5 am – 8 am	150
8 am – 12 noon	250
12 noon – 5 pm	300
5 pm – 9 pm	350
9 pm – 12 midnight	150

CO3 09

It is proposed to install a run off river plant and a steam plant for supplying the above load. The flow rate is 50 m^3/sec and is available for 96% of time during the year. The head is 92 meters, hydro efficiency is 90% and transmission losses are 5%. Determine the capacity of hydro and steam plant and suggest a schedule of plant output.

4 (a) What are the various bus bar arrangements employed in EHV substations? CO4 06

4 (b) Draw a layout of a typical 400kV/220kV EHV substation. List the various components of the layout.
Also explain the purpose of using line trap and coupling capacitor in EHV substations. CO4 09

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2023-24

B.TECH. (ODD SEMESTER) END SEMESTER EXAMINATION

ELECTRICAL ENGINEERING

SMART GRID (EEE-4360)

Maximum Marks: 60 Duration: 2 Hours

Attempt ALL questions

1. a)	Answer any **THREE** of the following (CO-1)	**(3x3)**
i.	Define 'prosumer' in the context of smart grid.	
ii.	Explain different levels of smart grid maturity model. Assess the progress in the Indian smart grid development as per this model.	
iii.	Smart grid is an integration of ICT with power grid. Justify.	
iv.	With the help of a suitable example explain the importance of Time of Day tariff in smart grid.	
b)	With the help of suitable examples explain the following features of a smart grid: • Self Healing • Asset Optimization • Power quality for digital economy	**(6)**
2. a)	Answer any **THREE** of the following (CO-2)	**(3x3)**
i.	Explain the concept and importance of state estimation in power grid?	
ii.	Distinguish AMR and AMI.	
iii.	Distinguish smart meter from a digital meter.	
iv.	Why the measurement from PMU carries an accurate time stamp?	
b)	Draw the block diagram of a wide area measurement system and mention in brief the function of each component.	**(6)**
3.	Answer any **FIVE** of the following (CO-3)	**(5x3)**
i.	For a given 3.3 MWp suppose the total generated units in a day is 9884 kWh. The generation was available for 13.25 hours. The average value of irradiance during a day is 225 W/m2. Total number of modules in the plant and area of each module are 10480 and 1.94 m2 respectively. Calculate the daily PR of the plant. Assume the efficiency of the PV module be 18.5 %.	
ii.	Why large-scale integration of green and renewable energy sources is one of the fundamental features of a smart grid?	
iii.	Explain anti-islanding feature of a grid connected inverter and why it is required?	
iv.	What is zero inertia challenge in smart grid with high penetration of grid connected solar PV plants?	
v.	Explain the CAPEX and RESCO models of grid integration of solar PV plants.	
vi.	Define different parameters used for performance evaluation of solar PV power plants.	
vii.	A 315 WP module has a PMax temperature de-rating factor of 760mW/°C. What is the temperature de-rating if the cell ambient temperature is 33°C?	

contd....2

viii.	Compare the net metering and net billing systems for grid integrated solar plants.	
4.	Answer any **FIVE** of the following (CO-4)	**(5x3)**
i.	What are the different sources of complexity in distribution systems? Why their complexity is increased in smart grid?	
ii.	Define distribution management system and its role in smart grid.	
iii.	What is a microgrid? Explain its different types and modes of operation.	
iv.	Mention different methods used for load forecasting. How the deployment of smart meters and distributed generation is affecting it?	
v.	Why power flow analysis for distribution systems is challenging?	
vi.	What is the difference between SCADA based and PMU based monitoring?	
vii.	Why state estimation in distribution systems is difficult as compared to transmission systems?	
viii.	Explain the requirements of a suitable energy management system in smart grid.	

Paper Code: 6571

2023-24

B. Tech. (ODD SEMESTER) EXAMINATION

(ELECTRICAL ENGINEERING)

NUMERICAL COMPUTATIONAL METHODS IN ELECTRICAL ENGG.

(EEE4710)

Maximum Marks: 60 **Duration: 2 Hours**

Answer all questions.
Assume suitable data, if required.
Notations and symbols used have their usual meaning.

Q.No.	Question	CO	M.M.
1(a)	Consider the first-order differential equation with input given. $$\frac{dy(t)}{dt} + 2y(t) = cos(4t)$$ Find the exact solution and write a MATLAB program to calculate the exact solution of the given first-order differential equation.	CO1	[08]
	OR		
1(a')	Write a program in MATLAB to solve the first-order differential equation given below as $$\frac{dx}{dt} = 1 + \frac{x}{t}, 1 \le t \le 3$$ with the initial condition x(1) = 1, using Runge kutta fourth order with step size of h = 0.1. Show a plot for x vs t.	CO1	[08]
1(b)	Write a program to arrange the elements of the following vector using the 'Selection Sort algorithm'. A = [64, 25, 12, 22, 11, 8]	CO1	[07]
2(a)	Given the component value for a parallel RLC Circuit as R= 100 Ω, L= 1 mH, C= μF and with the following initial conditions $i_L(0) = 0.25$ A and $v_c(0) = 6$V, determine the coefficients A and B.	CO2	[07]
	OR		
2(a')	Write a MATLAB program that calculates the expansion of e^x by Taylor series using 'For' loop.	CO2	[07]

Contd.... 2.

2(b) Define the following: CO2 [06]

(i) Interpolation function in Matlab

(ii) Debugging a program

2(c) In Matrix subscripting and indexing the command A (m:·n,:) for matrix A (mxn array) refers to ? CO2 [02]

3. Develop the Simulink model of a single phase inverter using both unipolar PWM and bipolar PWM. Clearly write the names of used blocks. For both cases, show the waveforms for switching signals, carrier signal, reference signal, output voltage. Comment on the result. CO3 [15]

4(a). Define the following terms used in LabVIEW: CO4 [08]

(i) Front Panel (ii) Terminals (iii) Shift Registers (iv) Structure Tunnels

4(b). Create a VI to find n_{C_r} and n_{p_r} of a given number using a 'For' Loop. Write the steps for creating the VI. Label all the components. Show the output result for $n = 6,\ r = 2$. CO4 [07]

OR

4'(a). Discuss the main components of a data acquisition system. CO4 [08]

4'(b). Create a VI to find the values and nature of roots of a quadratic equation. Mention all the steps. Label all the components. Show its output for the following quadratic equation: CO4 [07]

$$2x^2 + 6x + 7 = 0$$