

F 9119

(Pages : 2)

Reg. No.....

Name.....

**B.TECH. DEGREE EXAMINATION, NOVEMBER 2011**

**Seventh Semester**

Branch : Mechanical Engineering/Automobile Engineering

**INDUSTRIAL ENGINEERING (MU)**

(Regular/Supplementary)

Time : Three Hours

Maximum : 100 Marks

*Answer all questions.*

**Part A**

*Each question carries 4 marks.*

1. What are the factors affecting productivity ?
2. What are the kinds of productivity measures ?
3. Explain the meaning and significance of just in time.
4. What do you mean by cellular manufacturing ? Give a brief explanation stating the advantages and disadvantages.
5. What do you mean by flow diagram ? Explain how it is constructed.
6. Explain the principles of micromotion study.
7. Comment on BIS.
8. Comment on ISO.
9. Define inventory control. What are the types of inventories ? What are the objectives of inventory control ?
10. Explain how selling price of a product is calculated.

(10 × 4 = 40 marks)

**Part B**

*Each question carries 12 marks.*

11. (a) (i) Define productivity. How do you measure productivity ?  
(ii) There are two industries manufacturing two types of plugs. The standard time per piece is 1.5 minutes. The output of the two industries is 300 and 200 respectively per shift of 8 hours :
  - (a) What is the productivity of each per shaft of 8 hours ?
  - (b) What is the production of each per week (6 days) on the basis of double shift.

*Or*

- (b) Explain the ways to improve productivity.

**Turn over**

12. (a) Explain how plant layouts are made based on group technology.

Or

(b) Explain the various types of maintenance.

13. (a) Explain the various work measurement techniques.

Or

(b) Explain the principles of micromotion study.

14. (a) Describe the effects of industrial disputes. Also state the significant methods to prevent industrial disputes.

Or

(b) (i) Explain the objectives and functions of trade union.

(ii) What are the various types of communication ?

15. (a) Explain economic order quantity.

Or

(b) Explain any three destructive testing method.

(5 × 12 = 60 marks)

F 9148

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Reg. No.....

Name.....

**B.TECH. DEGREE EXAMINATION, NOVEMBER 2011**

**Seventh Semester**

Branch : Mechanical Engineering

**MACHINE DESIGN AND DRAWING—I (M)**

(Regular/Supplementary)

Time : Three Hours

Maximum : 100 Marks

*Answer any two from Part A and two from Part B.*

*Suitably assume any missing data.*

**Part A**

*Each question carries 25 marks.*

1. The load on a bolt consist of an axial thrust of 8 kN and transverse force of 8 kN. Calculate the diameter of the bolt according to (a) Maximum principal stress theory ; (b) Maximum shear stress theory ; and (c) Strain energy theory. Take factor safety to be 3. Given  $\sigma_y = 285 \text{ N/mm.}^2$  and  $\nu = 0.3$ .
2. Design a knuckle joint to transmit 5 kN axial tensile load. Allowable stresses in fork end, eye end and rod end pin are  $\sigma_a = 50 \text{ MPa}$  and  $\tau = 40 \text{ MPa}$  and  $\sigma_o = 80 \text{ MPa}$ .
3. Design a flange coupling to transmit 3000 kW power at 600 r.p.m. The allowable shear stress in the shaft and flange is 50 MPa. Allowable shear stress in the bolt is 40 MPa.
4. Two steel plates 200 mm.  $\times$  16 mm. thick are to be joined by the diamond rivetting arrangement using two cover plates. Allowable stresses are  $\sigma_t = 80 \text{ MPa}$ ,  $\tau = 60 \text{ MPa}$ ,  $\sigma_c = 100 \text{ MPa}$ . Determine (a) rivet diameter ; (b) thickness of cover plates ; (c) number of rivet ; (d) rivet arrangement ; and (e) tearing strength of plate in each row.

(2  $\times$  25 = 50 marks)

**Part B**

*Each question carries 25 marks.*

5. A close-coiled helical extension spring needs to be designed for a spring balance to measure a load of 50 kgf over a linear scale of 150 mm. The spring index is 8. Give complete specifications of spring.
6. A commercial shaft is supported on bearings 100 cm. between centres A 22.5 cm. pinnion and a 60 cm. pulley are located 25 cm., 75 cm. inside left bearing respectively. The shaft receives 25 HP through the horizontal belt while running at 400 r.p.m. and delivers it through the pinnion to a gear mounted on another shaft with a downward tangential force. The weight of pinnion and pulley are 25 kg. and 50 kg. respectively. Design the shaft.

**Turn over**

7. Design a connecting rod for a petrol engine with the following data :

Piston diameter = 80 mm.

Weight of reciprocating parts = 15 N

Centre to centre length of the rod = 250 mm.

Stroke = 110 mm.

RPM = 1500 with 50 % over drive

Compression ratio = 7 : 1

Maximum explosion pressure =  $2.5 \text{ N/mm}^2$

FOS = 5 for connecting rod and bolts.

8. A solid rectangular shaft of dimensions 60 mm.  $\times$  80 mm. is welded to a flat plate by a 6 mm. fillet on all sides. The shaft axis is perpendicular to the plane of plate. How much torque can be applied on the shaft, if the shear stress in the weld is not to exceed 95 MPa ?

(2  $\times$  25 = 50 marks)

F 9110

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Reg. No..... **ME**  
Name.....

**B.TECH. DEGREE EXAMINATION, NOVEMBER 2011**

**Seventh Semester**

**Branch : Mechanical Engineering**

**GAS DYNAMICS AND JET PROPULSION (M)**

**(Regular/Supplementary)**

**Time : Three Hours**

**Maximum : 100 Marks**

*Use of Approved Gas Tables and Chart are Permitted.*

**Part A**

*Answer all questions.  
Each question carries 4 marks.*

1. Express the stagnation enthalpy interms of static enthalpy and velocity of flow.
2. Define : Mach number and compressibility factor.
3. Sketch the isentropic and actual expansion through a nozzle and give the expression for nozzle Efficiency ?
4. Deduce the expression for impulse function and stream thrust.
5. Give the assumptions regarding Fanno Flow. What is fanno line ?
6. Define the terms : Friction choking and thermal choking with reference to Fanno and Rayleigh flow.
7. Discuss the significance of Rankine Hugoniat equation for an Normal shock and compare it with Isentropic compression of gas.
8. Define strength of a shock and why are expansion shocks impossible.
9. How is turbofan Engine different from turboprop Engine ?
10. What are the advantages of solid propell and rockets compared to liquid propellant Rockets ?

**(10 × 4 = 40 marks)**

**Part B**

*Each question carries 12 marks.*

11. (a) The pressure, temperature and Mach number at the entry of flow passage are 2.45 bar, 26.5°C and 1.4 respectively. If the exit Mach number is 2.5, determine for adiabatic flow of a perfect gas ( $\gamma = 1.3$ ,  $R = 469 \text{ J/kg K}$ ).
  - (i) temperature and velocity of gas at Exit.
  - (ii) Flow rate per square metre of the inlet cross section.
  - (iii) Stagnation temperature.

**(6 marks)**

**Turn over**

(b) What is the effect of Mach number on the compressibility? (6 marks)

Or

12. (a) Air ( $C_p = 1.05 \text{ kJ/kgK}$ ) ( $\gamma = 1.4$ ) at  $P_1 = 3 \times 10^5 \text{ N/m}^2$  and  $T_1 = 500 \text{ K}$  flows with a velocity of 200 m/s in a 30 cm diameter duct. Calculate :

- Mass flow rate ;
- Stagnation temperature ;
- Mach number ; and
- stagnation pressure values assuming the flow as compressible and incompressible respectively.

(10 marks)

(b) Define Coefficient of Compressibility. (2 marks)

13. Derive the Energy Equation  $\frac{a^2}{\gamma-1} + \frac{c^2}{2} - \frac{c^2}{3} \max = \frac{a_0^2}{\gamma-1} = h_0$  stating the assumptions used. An

air jet ( $\gamma = 1.4$ ,  $R = 287 \text{ J/kg K}$ ) at 400 K has sonic Velocity. Determine.

(4 marks)

- Velocity of sound at 400 k and at stagnation conditions. (4 marks)
- Maximum velocity of the Jet and stagnation Enthalpy. (4 marks)

Or

14. A nozzle in a wind tunnel gives a test section Mach number of 2.0. Air enters the nozzle from a large reservoir at 0.69 bar and 310 K. The cross-sectional area of the throat is 1000 cm<sup>2</sup>. Determine the following quantities for the tunnel for one dimensional Isentropic flow :

- Pressure, temperature and velocities at the throat and test sections. (4 marks)
- Area of cross section of test sections and Mass flow rate. (4 marks)
- Power required to drive the compressor. (4 marks)

15. A long pipe of 25.4 mm diameter has a mean coefficient of friction of 0.003. Air enters the pipe at a Mach number of 2.5, stagnation temperature 310 K and static pressure 0.507 bar. Determine for a section at which the Mach number reaches 1.2,

- Static Pressure and temperature ;
- Stagnation Pressure and Temperature ;
- Velocity of air ;
- distance of this section from the inlet ; and
- mass flow rate of air.

(12 marks)

Or

16. (a) The conditions of a gas in combustor at entry are :  $P_1 = 0.343 \text{ bar}$ ,  $T_1 = 310 \text{ K}$ ,  $C_1 = 60 \text{ m/s}$ . Determine the Mach number, pressure, temperature and velocity at the exit if the increase in stagnation Enthalpy of the gas between entry and exit is 1172.5 kJ/kg Assume  $C_p = 1005 \text{ J/kgK}$  and  $\gamma = 1.4$  for gas.

(10 marks)

(b) Under what conditions the assumption of Rayleigh flow is not valid in a heat exchanger ?

(2 marks)

17. Starting from the energy equation for flow through a normal shock. Obtain the following relations :  $M_x^* M_y^* = 1$  and  $C_x C_y = a^{*2}$ . Also derive the Rankine Hugoniot relation for a Normal Shock wave.

(6 + 6 = 12 marks)

Or

18. (a) Write down the four basic equations which satisfy the state points before and after a Normal shock wave.

(4 marks)

(b) An Aircraft flies at a Mach number of 1.2 at an altitude of 16,000 m ( $P = 103 \text{ m bar}$ ,  $T = 216.65 \text{ K}$ ). The compression in its Engine is partly achieved by a normal shock wave standing at the entry of its diffuser. Determine immediately downstream of the shock ;

- Mach number ;
- Temperature and pressure at air and
- stagnation Pressure loss across the shock.

(8 marks)

19. Explain the working of following Jet Engines :—

- Turbo Jet Engine ;
- RamJet Engine.

(6 + 6 = 12 marks)

Or

20. Explain briefly what is meant by :

- Monopropellants ;
- Hypergolic propellants ;
- Specific Impulse ;
- Effective Jet Velocity ;
- Specific Propellant consumption and
- Propulsive efficiency.

(6 × 2 = 12 marks)

[5 × 12 = 60 marks]

F 9127

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Reg. No.....

Name.....

**B.TECH. DEGREE EXAMINATION, NOVEMBER 2011**

**Seventh Semester**

Branch : Mechanical Engineering/Automobile Engineering

**REFRIGERATION AND AIR CONDITIONING (MU)**

(Regular/Supplementary)

Maximum : 100 Marks

Time : Three Hours

*Use of R and AC Tables, charts and steam tables are permitted.*

**Part A**

*Answer all questions.  
Each question carries 4 marks.*

1. Define : COP of Refrigerator and Tonne of Refrigeration.
2. Compare the various air cooling systems used for aircraft.
3. Sketch the T-S and P-h diagrams for vapour compression refrigeration cycles when vapour after compression is (a) Superheated and (b) Dry saturated.
4. State the advantages of Multi-stage vapour compression Refrigeration with Intercoolers ?
5. Explain the working of Magnetic Refrigeration system.
6. Discuss in detail, the secondary refrigerants.
7. Explain the working principle of Hermetically sealed compressor.
8. What are the factors affecting the heat transfer capacity of an Evaporator ?
9. Write a short note on :
  - (a) By pass factor for cooling coils and
  - (b) Dehumidification.
10. Discuss, briefly the factors affecting the optimum effective temperature for comfort. (10 × 4 = 40 marks)

**Part B**

*Each question carries 2 marks.*

11. An Aircraft moving with a speed of 1000 kmph uses simple gas refrigeration cycle for Air conditioning. The ambient pressure and temperature are 0.35 bar and  $-10^{\circ}\text{C}$  respectively. The pressure ratio of compressor is 4.5. The heat exchanger effectiveness is 0.95. The isentropic efficiencies of compressor and Expander are 0.8 each. The cabin pressure and temperature are 1.06 bar and  $25^{\circ}\text{C}$ . Determine temperature and pressures at all points of cycle. Also find the

**Turn over**

volume flow rate through the compressor inlet and Expander outlet for 100 Ton of Refrigeration. Assume  $C_p = 1005 \text{ J/kg K}$ ,  $R = 287 \text{ J/kg k}$ ,  $\gamma = 1.4$  for air and  $1 \text{ TR} = 3.5 \text{ kW}$ .

(12 marks)

Or

12. (a) Compare a refrigerator with an heat pump and Heat Engine. (6 marks)
- (b) The capacity of a refrigerator is 70 kW when working between  $-6^\circ\text{C}$  and  $25^\circ\text{C}$ . Determine the mass of ice produced per day from water at  $25^\circ\text{C}$ . Also find the power required to drive the unit. Assume that the cycle operates on reversed Carnot cycle and the latent heat of ice is  $335 \text{ kJ/kg}$ . (6 marks)
13. A vapour compression cycle uses R 12 as refrigerant and the liquid evaporates in the evaporator at  $-15^\circ\text{C}$  the temperature of this refrigerant at the delivery from the compressor is  $15^\circ\text{C}$  when the vapour is condensed at  $10^\circ\text{C}$ . Find the COP, if
- (a) there is no undercooling ; and
- (b) the liquid is cooled by  $5^\circ\text{C}$  before expansion by throttling. Assume  $C_{pv} = 0.64 \text{ kJ/k}$  (for superheated vapour) and that of liquid  $C_{pl} = 0.94 \text{ kJ/kgK}$ .

Temperature $^\circ\text{C}$	Enthalpy $\text{kJ/kg}$		Specific Entropy $\text{kJ/kgK}$	
	Liquid	Vapour	Liquid	Vapour
$-15^\circ\text{C}$	22.3	180.88	0.0904	0.7051
$+10^\circ\text{C}$	45.4	191.76	0.1750	0.6921

(12 marks)

Or

14. The Refrigeration system using R12 as refrigerant consists of 3 Evaporators of capacities 20 TR, 30 TR and 10 TR with individual expansion valves and individual compressors. The temperature in the three evaporators is to be maintained at  $-10^\circ\text{C}$ ,  $5^\circ\text{C}$  and  $10^\circ\text{C}$  respectively. The vapour leaving the evaporators are dry and saturated. The condenser temperature is  $40^\circ\text{C}$  and the liquid refrigerant leaving the condenser is subcooled to  $30^\circ\text{C}$ . Assuming Isentropic compression in each compressor, find
- (a) the mass of refrigerant flowing through each evaporator ; (4 marks)
- (b) power required to drive the system ; and (4 marks)
- (c) COP of system. (4 marks)

15. (a) Draw a neat diagram of Lithium-Bromide system and explain its working. List the major field of applications of this system. (6 + 2 = 8 marks)

(6 + 2 = 8 marks)

- (b) State the advantages and disadvantages of Li-Br compared to vapour compression Refrigeration system. (4 marks)

(4 marks)

Or

16. (a) Write the factors considered for selection of refrigerant for a system. (6 marks)
- (b) Explain the working of steam Jet Refrigeration system with a neat sketch. (6 marks)
17. (a) Compare the performance of Reciprocating and centrifugal compressors. (6 marks)
- (b) Explain the working of a thermostatic expansion valve. (6 marks)

(6 marks)

Or

18. (a) Compare an Air-cooled condenser with water-cooled condenser. (6 marks)
- (b) Explain the working of a flooded evaporators. (6 marks)
19. (a) The humidity ratio of atmospheric air at  $28^\circ\text{C}$  DBT and 760 mm of Hg is  $0.016 \text{ kg/kg}$  of dry air. Determine :
- (i) Partial pressure of water vapour ;
- (ii) Relative humidity ;
- (iii) Dew point temperature ;
- (iv) Specific Enthalpy ; and
- (v) Vapour Density. (8 marks)

(8 marks)

- (b) Define thermodynamic wet bulb temperature. (2 marks)

(2 marks)

- (c) What is the function of Humidstat in an A/C ? (2 marks)

(2 marks)

Or

20. (a) Explain in detail summer and winter air conditioning systems. (4 + 4 = 8 marks)
- (b) Define By pass factor of cooling coil. (1 mark)
- (c) Describe the different methods of air conditioning duct design. (3 marks)

(1 mark)

(3 marks)

[5 × 12 = 60 marks]



F 9137

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Reg. No.....

Name.....

**B.TECH. DEGREE EXAMINATION, NOVEMBER 2011**

**Seventh Semester**

Branch : Mechanical Engineering

**DYNAMICS OF MACHINERY (M)**

(Regular/ Supplementary)

Time : Three Hours

Maximum : 100 Marks

**Part A**

Answer all questions.

Each question carries 4 marks.

1. Sketch a thin rotor with multiple mass concentrations in its central plane at different angles and using the sketch of its "mr- polygon" describe how this rotor can be balanced.
2. Draw the direct crank and reverse crank of a single cylinder reciprocating engine and describe how it can be used to analyze the unbalance in a radial engine.
3. Find the frequency of free vibrations of a system shown in figure. 1. Neglect the weight of the beam AB.

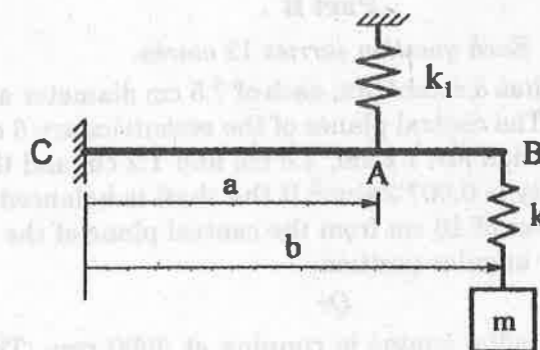


Fig. 1

4. Derive an expression for the Force transmitted to the base of a simple spring, mass and damper system excited by a force  $f = F \sin \omega t$ .

Turn over

5. Obtain the frequency equation of a two degree of freedom system shown in figure.2.



Fig. 2

6. Deduce Dunkerlay's empirical formula for finding the fundamental natural frequency of simply supported beam carrying several point loads.
7. What is a Dirac delta function? Obtain the Laplace transform of the Dirac delta function.
8. Describe how vibrations of a violin string are sustained by dry friction?
9. What do you mean by Octave band analysis?
10. Define the term "Loudness". How does it vary with frequency?

(10 × 4 = 40 marks)

**Part B***Each question carries 12 marks.*

11. A shaft running at 600 rpm has 3 eccentrics, each of 7.5 cm diameter and 2.5 cm thick, machined in one piece with the shaft. The central planes of the eccentrics are 6 cm apart. The distances of centres from the axis of rotation are 1.2 cm, 1.8 cm and 1.2 cm and their angular positions are 120° apart. The metal density is 0.007 kg/cm<sup>3</sup>. If the shaft is balanced by adding two weights at radius 7.5 cm and at distances of 10 cm from the central plane of the middle eccentric, find the amount of weights and their angular position.
- Or
12. A four stroke five cylinder radial engine is running at 3000 rpm. The reciprocation mass per cylinder is 2 kg, crank radius is 5 cm, connecting rod length is 25 cm. Investigate the state of primary and secondary unbalance in the engine by direct and reverse crank method.
13. A torsional pendulum has a frequency of 200 cycles per minute when vibrating in vacuum. The mass moment of inertia of the disc is 0.2 kg-m<sup>2</sup>. It is then immersed in oil and its frequency is found to be 180 cycles per minute. Determine the damping constant. If the disc when placed in oil, is given an initial displacement of 2°, find its displacement at the end of the first cycle.

Or

14. A sensitive instrument with a mass of 113 kg is to be installed at a location where the acceleration is 15.24 cm/s<sup>2</sup> at a frequency of 20 Hz. It is proposed to mount the instrument on a rubber pad with the following properties:  $k = 2800$  N/cm, and  $\xi = 0.10$ . What acceleration is transmitted to the instrument?

15. Derive the frequency equation for the system shown in Fig. 3. Assume that the rope passing over the pulley does not slip. What will be its natural frequencies if  $m_1 = 5$  kg,  $m_2 = 10$  kg,  $k_1 = 100$  N/cm,  $k_2 = 50$  N/cm and  $r = 15$  cm.

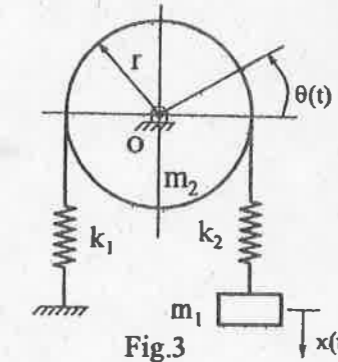


Fig.3

Or

16. A structure supporting rotating machinery vibrates excessively at an excitation frequency of 18 Hz. It is proposed to attach a vibration absorber tuned to this frequency. What should be the absorber mass and stiffness so that the resulting two natural frequencies are at least 20% away from the excitation frequency? The effective mass of the structure is 1 tonne and its natural frequency is 16 Hz.
17. Using Laplace transform, determine the response of an undamped single degree of freedom system of natural frequency  $\omega_n$  and mass  $M$  when it is subjected to a constant force of magnitude  $F_0$ . The system is at rest at time  $t = 0$ .
- Or
18. Use a straightforward perturbation expansion to develop a two-term approximation to the solution of Duffing's equation  $\ddot{x} + 2\mu\dot{x} + x + \epsilon x^3 = F \sin \omega t$  with  $F = 0$ .
19. In the same area of a warehouse, there are four large machines. Machine 1 produces a sound power of 1 W. Machine 2, 3, and 4 produces an acoustical power of 0.5 W, 0.75 W and 1.25 W respectively. What is the total power level generated in the area by the four machines?
- Or
20. What do you mean by overall Sound Pressure Level (SPL)? A diesel powered heavy truck has the noise sources with SPL as (1) straight exhaust: 98 dB, fan 88 dB, engine: 83 dB, air intake : 75 dB, other sources: 75 dB. What is its overall SPL?

(5 × 12 = 60 marks)

**F 9169**

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Reg. No.....

Name.....

**B.TECH. DEGREE EXAMINATION, NOVEMBER 2011**

**Seventh Semester**

Branch : Mechanical Engineering

**MARKETING AND SALES MANAGEMENT (Elective I) [M]**

(Regular/Supplementary)

Time : Three Hours

Maximum : 100 Marks

*Answer all questions.*

**Part A**

*Each question carries 4 marks.*

1. Comment on the meaning and importance of Price.
2. Differentiate between Marketing and Sale.
3. What are the elements of a marketing strategy ?
4. What are the conditions that would lead a manager to adopt a primary demand strategy ?
5. Write about the market testing of a new product.
6. What are the advantages and disadvantages of online marketing ?
7. Explain how motivation influence customer buying behaviour.
8. Explain how perception influence customer buying behaviour.
9. Explain the need of training sales personnel.
10. Explain the factors to use in setting a variable sales quota.

(10 × 4 = 40 marks)

**Part B**

*Each question carries 12 marks.*

11. (a) Explain the environmental variables of marketing.

*Or*

- (b) Explain the term marketing research.

12. (a) Explain how market potential and industries sales measures are important in the selection of a marketing strategy.

*Or*

- (b) Explain the various types of marketing strategies.

13. (a) Explain the marketing strategies at the maturity stage.

*Or*

- (b) Explain the marketing strategies at the decline stage.

**Turn over**

14. (a) List and explain the individual determinants of consumer behaviour.

Or

(b) Explain the various types of buying behaviour.

15. (a) Explain the major steps in effective selling.

Or

(b) Explain the factors to be considered while designing a sale force.

(5 × 12 = 60 marks)

Maximum : 100 Marks

Time : Three Hours

Answer all questions.

Part A

Each question carries 4 marks.

1. Comment on the meaning and importance of Price.
2. Differentiate between Marketing and Sale.
3. What are the elements of a marketing strategy?
4. What are the conditions that would lead a manager to adopt a primary demand strategy?
5. Write about the market testing of a new product.
6. What are the advantages and disadvantages of online marketing?
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8. Explain how perception influence customer buying behaviour.
9. Explain the need of training sales personnel.
10. Explain the factors to use in setting a variable sales quota.

(10 × 4 = 40 marks)

Part B

Each question carries 12 marks.

11. (a) Explain the environmental variables of marketing.  
Or  
(b) Explain the term marketing research.
12. (a) Explain how market potential and industries sales measures are important in the selection of a marketing strategy.  
Or  
(b) Explain the various types of marketing strategies.
13. (a) Explain the marketing strategies at the maturity stage.  
Or  
(b) Explain the marketing strategies at the decline stage.

Turn over

**B.TECH. DEGREE EXAMINATION, NOVEMBER 2011**

**Seventh Semester**

**Branch : Mechanical Engineering**

**ADVANCED OPERATIONS RESEARCH (Elective-I) (M)**

**(Regular/ Supplementary)**

**Maximum : 100 marks**

**Time : Three Hours**

*Answer all questions.*

**Part A**

*Each questions carries 4 marks.*

1. What is the significance of sensitivity analysis?
2. What do you mean by duality? What is the significance of dual variables in simplex solution?
3. Write the steps for solving a transportation problem.
4. Write the steps for stepping stone method.
5. Write the steps of Gomory's all integer programming algorithm.
6. Differentiate between linear programming and goal programming approach.
7. Discuss the general features of dynamic programming.
8. Define the following dynamic programming terms :
  - (i) Stage.
  - (ii) State variable.
  - (iii) Decision variable.
  - (iv) State Transformation function.
9. Explain what factors must be considered while designing a simulation experiment.
10. What are the general features of binomial distribution? (10 × 4 = 40 marks)

**Part B**

*Each question carries 12 marks.*

11. Use graphical method to solve the following LP problem :

Minimize  $Z = 20x_1 + 10x_2$

subject to constraints

$x_1 + 2x_2 \leq 40$

$3x_1 + x_2 \geq 30$

$4x_1 + 3x_2 \geq 60$

$x_1, x_2 \geq 0.$

Or

Turn over

12. Use simplex method to solve the following LP problem :

Minimize  $Z = 3x_1 + 5x_2 + 4x_3$   
 subject to constraints  
 $2x_1 + 3x_2 \leq 8$   
 $2x_1 + 5x_3 \leq 10$   
 $3x_1 + 2x_2 + 4x_3 \leq 15$   
 $x_1, x_2, x_3 \geq 0.$

13. Solve the following transportation problem :

		Destination			Supply
		D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	
Source	S <sub>1</sub>	2	7	4	5
	S <sub>2</sub>	3	3	7	8
	S <sub>3</sub>	5	4	1	7
	S <sub>4</sub>	1	6	2	14
Demand		7	9	18	34

Or

14. Solve the following transportation problem :

		Destination				Supply
		D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	
Origin	O <sub>1</sub>	11	13	17	14	250
	O <sub>2</sub>	16	18	14	10	300
	O <sub>3</sub>	21	24	13	16	400
	Demand	200	225	275	250	950

Or

15. Solve the following all integer programming problem using Gomory's cutting plane algorithm :

Maximize  $Z = x_1 + 2x_2$   
 subject to  $2x_2 \leq 7$   
 $x_1 + x_2 \leq 7$   
 $2x_1 \leq 11$   
 $x_1, x_2 \geq 0.$

16. A firm produces two products A and B. Each product must be processed through two departments namely 1 and 2. Department 1 has 30 hours of production capacity per day and department 2 has 60 hours. Each unit of product A requires 2 hours in department 1 and 6 hours in department 2. Each unit of product B requires 3 hours in department 1 and 4 hours in department 2. Management has rank ordered the following goals it would like to achieve in determining the daily product mix.

- P<sub>1</sub> : Minimize the under achievement of joint total production of 10 units.
- P<sub>2</sub> : Minimize the under achievement of producing 7 units of product B.
- P<sub>3</sub> : Minimize the under achievement of producing 8 units of product A.

Formulate the problem as a GP model and then solve it by using graphical method.

17. Use dynamic programming to solve the following problem :

Minimize  $Z = y_1^2 + y_2^2 + y_3^2$   
 subject to the constraint

$y_1 + y_2 + y_3 \geq 15$   $y_1, y_2, y_3 \geq 0$

18. Use dynamic programming to solve the following problem :

Maximize  $Z = x_1^2 + 2x_2^2 + 4x_3$   
 subject to the constraint

$x_1 + 2x_2 + x_3 \leq 8$  and  $x_1, x_2, x_3 \geq 0$

19. A confectioner sells confectionery items. Past data of demand per week in hundred kilograms with frequency is given below :

Demand/week	0	5	10	15	20	25
Frequency	2	11	8	21	5	3

Using the following sequence of random numbers, generate the demand for next 15 weeks. Also find out the average demand per week.

Random number : 35, 52, 90, 13, 23, 73, 34, 57, 35, 83, 94, 56, 67, 66, 60.

Or

20. The manager of a book has to decide the number of copies of a particular book to order. A book costs Rs. 60 and sold for Rs. 80 since some of the tax laws change year after year, any copies unsold while the edition is current must be sold for Rs. 30. From past records, the distribution of demand for this-book has obtained as follows :

Demand (No. of Copies)	15	16	17	18	19	20	21	22
Proportion	0.05	0.08	0.20	0.45	0.1	0.07	0.03	0.02

Using the following sequence of random numbers, generate data on demand for 20 time periods (years) . Calculate the average profit obtainable under each of the course of action open to the manager. What is the optimal policy ?

14, 02, 93, 99, 18, 71, 37, 30, 12, 10, 88, 13, 00, 57, 69, 32, 18, 08, 92, 73.

(5 × 12 = 60 marks)